Michael [illegible], Jr.
New Orleans
Louisiana

HISTORY OF THE PANAMA CANAL



Painted by Henry Reuterdahl for the History of the Panama Canal.

FROM SEA TO SEA

The S. S. *Ancon* passing through the Pedro Miguel lock—the first steamer through the canal.

HISTORY

OF THE

PANAMA CANAL

ITS CONSTRUCTION AND BUILDERS

BY

IRA E. BENNETT

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PREFACE

IN THE ensuing pages an effort has been made to tell the plain, unvarnished story of Panama and the Panama Canal. The information contained herein has been gathered from many publications and from public and private persons. The records of the Government have been available at all times, to the writer, thanks to the courtesy of the authorities at Washington and of Major-General Goethals. Special acknowledgments are due to the Hon. William H. Taft, who, as Secretary of War and President of the United States, from 1904 to 1913, directed the affairs of the Panama Canal from its beginning to its virtual completion. In 1912 President Taft wrote to the author as follows:

THE WHITE HOUSE, Washington, March 25, 1912

MY DEAR MR. BENNETT:

I am very glad to hear from you that you contemplate publishing a history of the construction of the Panama Canal. There is a great deal of detail connected with it which is forgotten and yet which is interesting to know with respect to the great work. There are a good many facts, indeed, that have never been brought to the public attention, that are of record and ought properly to be put in an historical form.

I shall be very glad myself to furnish you with all the data that I have in my correspondence, which covers the whole life of the Canal from the very day that the Canal Zone was turned over by the Republic of Panama to the United States.

I am glad that such an enterprise is on foot.

Sincerely yours, WM. H. TAFT.

Cordial encouragement was extended, also, by the Hon. Henry L. Stimson, Secretary of War, and Col. George W. Goethals, Chairman and Chief Engineer of the Isthmian Canal Commission. Mr. Stimson wrote: "I think it is very important that a full and careful history of the construction of the Panama Canal should be written while people are still alive in whose memories many of the most important events will rest, and I am very glad to hear that you are contemplating publishing such a history. I should be glad to put at your disposal all the data that I properly can while in office here in the Department which has had supervision to a certain extent over the work."

Col. Goethals wrote: "I am very glad to hear from you that you contemplate publishing a history of the construction of the Panama Canal. To facilitate you in the enterprise I will take pleasure in authorizing you to collect information from any reliable source and give you access to the records for verification of such information or any additional data that may be available."

The author is indebted to Prof. Patrick J. Lennox, Professor of English Language and Literature at the Catholic University of America, for valuable assistance in preparing the history of the Isthmus of Panama. A master of the subject, his aid in critical researches through an extensive bibliog-

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raphy served to bring out what is believed to be a clear and concise account of the romantic developments that followed the discovery of Tierra Firme.

Equally important was the assistance rendered by Mr. William Joseph Showalter in the preparation of the history of canal construction. In conversation with the writer, Col. Goethals expressed his pleasure upon being informed that Mr. Showalter was engaged in this task, and he added: "Mr. Showalter knows more about the Panama Canal than any other man except myself. I wish some of my engineers knew as much."

No doubt many details of canal history cannot be ascertained or accurately weighed at this time; but it has been deemed wise to obtain from some of the makers of this history their own version of their activities, for the information of future historians. In this regard the chapters contributed by Messrs. John F. Wallace and John F. Stevens, respectively chief engineers of the Canal, are especially notable.

To the Associate Editors, contributors, and numerous American engineers, contractors, and industrial corporations cordial thanks are extended for co-operation and advice.

Although care has been taken to insure the accuracy of technical descriptions of equipment, machinery, and operations, it is hoped that the reader will bear in mind, when errors are noted, that the construction of the Panama Canal involved the energies of almost all branches of American industry, and that a review of these operations is almost equivalent to a description of a ten years' war.

Happily, however, the campaign conducted at Panama was constructive, not destructive; for the benefit of mankind, not for the killing of men and the conquest of nations; and more permanent glory was won by the gallant soldier who lost his life in the struggle at Panama than by those who count their triumphs in the number of men slaughtered in Europe. The name of the late Lieutenant-Colonel David DuBose Gaillard is perpetuated, not only by the renaming of Culebra Cut, but by the record of his own devotion, which will endure even if Gaillard Cut should be swept away.

The Panama Canal was completed at a time when war enveloped Europe. The story of its construction is offered in the hope that it will aid in reminding the world that

"Peace hath her victories,
No less renowned than war."

WASHINGTON,
May, 1915.

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CHAPTER I

THE DISCOVERY OF PANAMA

DISCOVERIES OF CHRISTOPHER COLUMBUS—OTHER EXPEDITIONS: OJEDA, NIÑO, PINZON, LEPE, AND BASTIDAS—DISCOVERY OF PANAMA BY BASTIDAS—COLUMBUS'S THIRD AND FOURTH VOYAGES—DISCOVERY OF SOUTH AMERICA—SEARCH FOR THE STRAIT—DISCOVERY OF WESTERN PANAMA—EXPLORATION OF VERAGUA—ESTABLISHMENT OF THE COLONY OF BELEN—ITS ABANDONMENT—RETURN OF COLUMBUS TO SPAIN—HIS DEATH.

CHRISTOPHER COLUMBUS'S discovery of previously unknown lands lying in the western sea, on his celebrated first voyage in 1492, naturally attracted the attention of adventurous spirits to the glorious possibilities of fame and fortune which the New World seemed to offer. Hence we find that expedition after expedition was fitted out in rapid succession to explore and exploit the territory which the intrepid admiral from Genoa had added to the dominions of Ferdinand and Isabella of Spain. Most interest was at first taken in the islands of which Columbus had actually acquired possession, and in the surrounding islands; but soon wider vistas opened before the gaze of the navigators, when what was at first vague, if hopeful, impression deepened into the certainty that a great continent was at hand for the enrichment and aggrandisement of courageous explorers.

Already while Columbus was absent from Spain on his second voyage (1493–1496), there was issued, on April 10, 1495, a royal proclamation giving Spaniards permission to settle in Hispaniola, and allowing private voyages elsewhither for discovery, exploration, and barter. Under licenses granted in accordance with this proclamation five different expeditions left Spain for the new lands during 1499 and 1500.

The first of these was led by Alonso de Ojeda, who had been with Columbus on his second voyage. With Ojeda there went at least two men of note. One was Juan de la Cosa, the celebrated pilot, who, accompanying Columbus in 1493, made the earliest map of the western world. The other, a native of Florence, was Amerigo Vespucci, from whom, by a strange freak of fortune, all America was destined to take its name. Ojeda had four ships, and setting sail from Santa María, near Cadiz, on May 20, 1499, he reached the coast of South America, some two hundred leagues east and south of the river Orinoco. He then skirted the coast in a north-westerly direction until he reached Cape de la Vela, from which point he appears to have left the mainland and steered for Hispaniola. A claim is sometimes made for Ojeda that he was the first to sight the country now known as Panama. This claim rests on the assumption that his coasting cruise did not stop at Cape de la Vela, but that he continued his course as far as Cabo Tiburon in Darien; but this opinion is not now generally held. He returned to Spain in June, 1500, arriving at Cadiz with a great number of Indian slaves.

The second expedition was in command of Pedro Alonso Niño, who had also been with Columbus on his second voyage. With Niño, there also went Cristobal Guerra. With only one small caravel of fifty tons, and thirty-three men, they sailed from Palos on or about June 1, 1499, and, like Ojeda, successfully made the South American coast. Niño also sailed in a north-westerly direction, trading as he went for guanin and pearls. He returned to Spain in April, 1500, with a goodly number of pearls; but, on a charge

of not fully accounting for his treasure, he was cast into prison, from which he was not freed for some time.

The next to try his fortune was Vicente Yañez Pinzon, who had been captain of the *Niña* on Columbus's first voyage. Sailing from Palos in December, 1499, Pinzon had four caravels, with which he reached the coast of Brazil, at a point now known as Cape St. Augustine, on January 20, 1500. He took possession of the country in the prescribed form for Spain, giving it the name of Santa María de la Consolacion, but, as we shall see later, this act of his was of no avail, and Brazil was subsequently ceded to Portugal. To Pinzon belongs the distinction of being the first to cross the equator in the western part of the Atlantic. He, like the others who had preceded him, sailed north and west and discovered the Amazon. In the Gulf of Paria he landed and cut a cargo of Brazil-wood. On the way home he had the misfortune to lose two of his vessels and many of his men, so that when he arrived back at Palos his welcome was none too cordial.

A fellow townsman of Pinzon's, Diego de Lepe, sailed from Palos early in 1500 with two vessels. He went farther south along the American coast than any of his predecessors, and in this respect set up a record that stood for more than ten years.

In 1500 Cristobal Guerra made a second voyage to the Pearl Coast, which had some financial success. He was back in Spain before November 1, 1501.

From the point of view of this history the most important of the five expeditions was the last. Its leader was Rodrigo de Bastidas, a notary of Triana, a suburb of Seville. He was a man of position and education, and in character formed a strong contrast to most of the explorers who had preceded him, or were to come after him. Taking with him Juan de la Cosa, who had just returned with Ojeda, and accompanied also by Vasco Nuñez de Balboa, of whom we shall hear more presently, Bastidas set out from Cadiz in two ships in October, 1500. He reached that portion of South America which is now known as Venezuela, and, steering westward, he passed Cape de la Vela, explored the Gulf of Darien and the mouth of the Atrato River, and sailed along the northern shore of the isthmus as far as El Retrete, perhaps even as far as the site of Nombre de Dios, and possibly as far as Porto Bello. To Bastidas, therefore, belongs the credit of the discovery of the country now called Panama. He had great success in trading for guanin, pearls, and gold, and he also took a number of the natives as slaves. His career of exploration was brought to an end by the leaky condition of his ships, caused by the ravages of the teredo. He accordingly proceeded to Hispaniola, intending to sail thence for Spain, but his two ships sank in the port of Jaraguá, and most of his slaves were drowned and some Brazil-wood, gold, and pearls were also lost. He managed to save the most precious and portable part of his cargo, and, placing it on the backs of the surviving slaves, he started to march for Santo Domingo, which was about seventy leagues distant in an easterly direction. Arrived there, he was seized and thrown into prison by the governor of Hispaniola on the charge of illicit trading with the Indians. Francisco de Bobadilla, the retiring governor, who had recently been superseded by Don Nicolás de Ovando, was about to return to Spain with the large fleet that had brought out his successor. Accordingly, Bastidas was ordered to accompany him thither to have his case tried. Those who are familiar with the career of Columbus will remember that he was just then in the vicinity of Santo Domingo, on his fourth voyage. His former experience enabled him to predict a hurricane, and he begged of Ovando not to allow the fleet to start on the homeward voyage for at least eight days. He was laughed to scorn for his pains, and the fleet set out (July, 1502), but it had no sooner cleared the island than a fierce storm broke, which sank more than twenty of the ships. Among those lost was Bobadilla, who, in

1500, had sent Columbus home to Spain in chains. The Admiral's own little fleet of four vessels, being handled with superior seamanship, managed to ride out the storm. It is a curious fact that only one vessel of Bobadilla's fleet, and that the worst, *La Aguja*, with gold and other goods belonging to Columbus aboard, survived the hurricane in sufficiently good shape to proceed onward to Spain. All the circumstances considered, it is no wonder that the ordinary seamen believed that their Admiral had used "art magic" to confound and destroy his enemies and at the same time save himself, his ships and crews, and his possessions.

Out of the great Ovando-Bobadilla fleet a few badly battered vessels crawled back to Santo Domingo, and on one of them was Bastidas. When he ultimately reached Spain, he had no trouble in establishing his innocence before Ferdinand and Isabella. From the salvage he had made when his two vessels sank in Jaraguá Harbour, he paid a goodly royalty into the Spanish treasury, and he and Cosa were each granted a yearly pension of 50,000 maravedis, Cosa, in addition, receiving the appointment of alguacil mayor of Urabá. As an inducement to other intending explorers, three chests of gold and pearls, which Bastidas had collected, were displayed by royal order in all the towns through which he passed.

While these smaller men were thus engaged, the great high admiral himself was making his third and fourth voyages. On his third expedition he discovered the mainland of South America on August 1, 1498, and, in the belief that it was an island, he named it La Isla Santa, or Holy Island. A few days later he explored the land around the cape and gulf of Paria and, still in the same belief, called it Isla de Gracia, or Island of Grace. A coasting cruise of about 150 miles westwardly along the northern coast of Paria at length convinced him that he was dealing, not with an island, but with a Tierra Firme or continent. He had now, as he thought, discovered two continents: Cuba on the north with its western coast extending indefinitely to the south, and Paria on the south with its shores extending indefinitely to the west. The object of his fourth voyage therefore was to discover a narrow water-passage, running between these two mainlands, through which, as he imagined, the waters of the Atlantic flowed into the Indian Ocean. This strait once discovered, he could sail around the world and get back to Spain by way of the Cape of Good Hope.

Accordingly, armed with credentials to the eastern potentates whom he hoped to encounter, carrying interpreters versed in Arabic, with provisions for two years, and trinkets and other goods to barter with the Indians for gold, Columbus sailed, on his fourth and last voyage, from Cadiz on May 11, 1502. His little fleet consisted of four ships, ranging from 70 to 50 tons. His brother Bartolomé, the Adelantado, was captain of one of them, and the crews numbered, all told, one hundred and fifty. Among them was Columbus's second son, Fernando, then not quite fourteen years old, who in later years wrote a life of his father, in which he gave a detailed account of this fourth voyage. After putting in at Arcila on the Atlantic coast of Morocco, at the Canaries, at Martinio (which is perhaps Martinique), at Santo Domingo and other ports of Hispaniola, at the Morant Keys off Jamaica, and at the Queen's Gardens off the southern shore of Cuba, they steered south-south-west in the direction of the supposed strait, which Columbus felt confident was about Veragua and Nombre de Dios, as those places came subsequently to be known.

Towards the end of July they arrived at an island called Guanaja (the modern Bonacao or Bonacca). Near this island they captured two large canoes, the property of a cacique, evidently out on a trading voyage, for they contained an assortment of articles the like of which no Spaniard had previously seen in those parts. There were cups, bells, and hatchets made of

copper, cloaks and tunics of dyed cotton beautifully worked, knives of obsidian, wooden swords edged with flint, bread and beer, and cacao or chocolate beans. The men and women wore clothing, and were evidently more highly civilized than any Indians Columbus had previously seen. He began to think that at last he was about to get into touch with the strange races of the East. By using signs and the native dialect of Hispaniola, the Spaniards learned that their captives had come from a westerly land distant several days' journey, and that there gold, pearls, and spices were to be found in plenty. On learning this intelligence Columbus allowed them all to go, except one old man whom he kept for a guide.

From Guanaja the admiral continued his southerly course and found a cape, which he named Caxinas, and which is now known as Cape Honduras. Here the land ran east and west, and when Guimba, as the guide was called, was asked from which direction the gold came, he lied like a gentleman and pointed to the east. That gesture changed the history of the western world. Had he pointed the other way, where Yucatan, his own country, lay, Mexico would probably have had a more merciful conqueror than Cortés, and the Isthmus of Panama might never have become, as it subsequently did, the great entrepôt for the commerce of the east and the west. Guimba was dismissed with presents, and the fleet proceeded, in the direction he had indicated, along the coast of Honduras, meeting with the most terrible storms, until they reached a narrow point, from which the land turned south, and the weather improved. To this point they gave the appropriate name of Gracias á Dios, or Thanks to God. They then sailed along the coast of Nicaragua and Costa Rica, stopping at various points to barter with the natives, and on October 6 dropped anchor in Almirante Bay within the confines of the modern Panama. Thus Bastidas, sailing from South America to the west, and Columbus, sailing from Honduras to the east and south, discovered at different times different parts of Panama.

Columbus continued eastward past Chiriqui and Veragua until he reached Puerto Bello, to which he gave that name, as his son tells us, because it was "large, well peopled, and encompassed by a well-cultivated country." On November 24 he reached his farthest easterly harbor, to which he gave the name of El Retrete. Unable to contend any longer against the fierce easterly and north-easterly winds, he decided to turn back to Veragua to see for himself whether its mines were as rich as report made them. It was on December 5 that the start of the journey back to Veragua was made. He now encountered fierce westerly winds, and it was not until January 6, 1503, the feast of the Epiphany, that he anchored in Veragua, at a place to which he gave the name of Nuestra Señora de Belen, or Our Lady of Bethlehem, because that was the anniversary of the day on which the Wise Men reached Bethlehem of Judaea. In this vicinity there appeared so many evidences of mineral wealth that Columbus decided to leave a garrison to hold the country, and to go back himself to Spain to bring out reinforcements. To Ferdinand and Isabella he wrote in the following July a most glowing account of the gold in Veragua and of the fertility of its soil and the timidity of its inhabitants. The little garrison or colony was to consist of eighty men under the command of the Adelantado, and one of the ships, the *Gallego*, with all her stores, was to be left for their use. A storehouse was erected and huts of timber roofed with palm leaves were built. But the Quibian, or chief man of the district, not liking these proceedings, began to show signs of hostility. He and several of his warriors were therefore seized, the intention being to bring them to Spain and hold them as hostages for the good behavior of the rest. But the Quibian escaped, and at a time when nearly all the garrison was engaged with the getting out of the Admiral's ships, and only about twenty men were at Belen with

the Adelantado, an attack was made, which it took all the undaunted courage of Don Bartolomé to repel. Another attack forced the handful of Spaniards to abandon their settlement, which was exposed to enemies concealed in the jungle, and to entrench themselves on a piece of open beach, where they were out of reach of arrows from the woods. Luckily for them the admiral had not yet sailed, and after considerable difficulty all the men and stores were safely taken aboard, the dismantled and worm-eaten hulk of the *Gallego* being the only thing left behind. Thus ended the first attempt to colonize or garrison Panama.

Columbus now beat up the coast eastward, past the Chagres River and Limon Bay, until he again reached Puerto Bello, where one of his three remaining ships, the *Biscaina*, had to be abandoned on account of her extremely leaky condition. He still continued eastward for about ten leagues, and then, on May 1, 1503, from Marmora, as his son Fernando calls it, stood out to the north for Hispaniola. The identification of Marmora is difficult. Some are of opinion that Columbus went as far as Cape Tiburon and saw the Gulf of Urabá or Darien; a more probable opinion is that the most easterly point he reached in Panama was Punta Mosquito. When he headed for Hispaniola his ships were practically unseaworthy, and only the most strenuous bailing with pumps and kettles prevented them from being entirely swamped. Contrary winds and currents carried him far out of his course, and considering that he could never make Hispaniola, he steered for Jamaica, where, at Puerto Bono, he arrived on June 24. Next day he moved into another more easterly harbor, into which he had once before put during his second voyage in 1494, and to which he had then given the name of Santa Gloria. Here he ran his two worn-out vessels aground, shored them up so that they could not move, and built sheds on them for the protection of himself and his men. In July two of his lieutenants put off for Hispaniola in canoes, and after a long delay returned with two ships. In the meantime there had been a mutiny against Columbus by fifty of his men, which was put down by the bravery of the Adelantado and fifty of his staunch supporters.

On the two ships brought from Hispaniola Columbus and the survivors set out, on June 28, 1504, for Santo Domingo, but met with such adverse winds that they did not arrive at that city until August 13. The admiral started on his last voyage from the West Indies for Spain on September 12, and, after a stormy passage, dropped anchor in the harbor of San Lúcar on November 7, 1504. Here ended the active life of the high admiral of the ocean sea.

Less than two years later, on Ascension Day, May 20, 1506, with the chains in which he had once returned to Spain hanging over his bed in an inn at Valladolid, Christopher Columbus, worn out with disease and heart-broken with disappointment and ingratitude, received the last sacraments of the Church of which he was so loyal a son, and with the pious expression of faith, *In manus tuas, Domine, commendo spiritum meum*, on his lips, brought to an end his wonderful and glorious career.

CHAPTER II

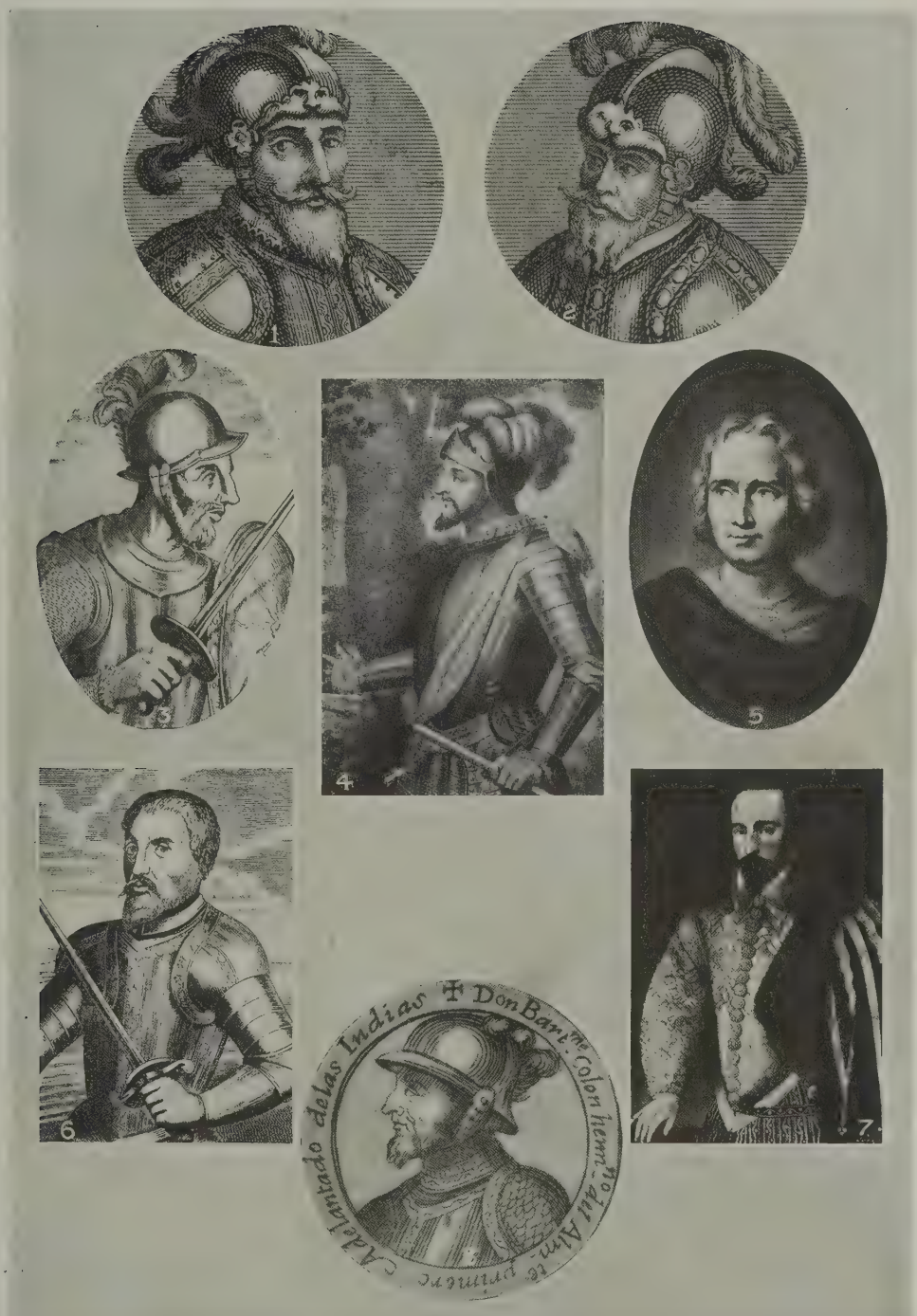
EARLY SETTLEMENTS

TIERRA FIRME: ITS MEANING—TIERRA FIRME DIVIDED INTO TWO PROVINCES—OJEDA APPOINTED GOVERNOR OF NUEVA ANDALUCÍA—NICUESA APPOINTED GOVERNOR OF CASTILLA DEL ORO—DEATH OF JUAN DE LA COSA—OJEDA AND NICUESA JOIN FORCES TO ATTACK THE INDIANS—FOUNDATION OF THE COLONY OF SAN SEBASTIAN—SAD PLIGHT OF THE SETTLERS—ADVENTURES OF OJEDA—HIS DEATH—PIZARRO IN COMMAND AT SAN SEBASTIAN—ARRIVAL OF ENCISO—BALBOA EMBARKS AS A STOWAWAY—FOUNDATION OF THE COLONY OF SANTA MARIA DE LA ANTIGUA DEL DARIEN—DEPOSITION OF ENCISO—BALBOA AND ZAMUDIO APPOINTED ALCALDES—ARRIVAL OF COLMENARES—WANDERINGS AND SUFFERINGS OF NICUESA—HE FOUNDS THE COLONY OF NOMBRE DE DIOS—HE GOES TO ANTIGUA BY INVITATION AND IS REFUSED ADMISSION—HIS SAD FATE.

TIERRA FIRME, or continent, was at first a general term applied to the whole of a vaguely known mainland which Columbus had discovered; but gradually that phrase received a narrower and more definite meaning by being applied particularly to the land which lay between Cape de la Vela on the east and Cape Gracias á Dios on the west. The report made by Columbus of the fertility and mineral wealth of Veragua, and the pearls and gold found by Bastidas in a more easterly direction, as well as the fact that no one had yet discovered a limit to the continent, helped King Ferdinand to realize more clearly the riches and magnitude of the country which the recent explorations had added to his dominions. He resolved therefore not to revive the office of Viceroy of the Indies vacant on Columbus's death, and to treat all his western dependencies as an appanage of the crown to be administered by governors or other officials appointed directly by himself. In 1509, in accordance with this policy, he divided Tierra Firme, in its narrower sense, into two provinces, to one of which was given the name of Nueva Andalucía, or New Andalusia, and to the other that of Castilla del Oro, or Golden Castile. Nueva Andalucía occupied the east, and Castilla del Oro the west, of Tierra Firme. Alonso de Ojeda, who had sailed with Columbus in 1493 and had undertaken two other western voyages on his own account in 1499 and 1502, was appointed governor of Nueva Andalucía. The government of Castilla del Oro was given to Diego de Nicuesa, a favorite at court, who had accompanied Nicolás de Ovando when the latter went out to supersede Bobadilla as governor and judge of Hispaniola in 1502. In this way Ferdinand hoped to colonize and develop a section of territory that promised so well.

At Santo Domingo, in Hispaniola, where the two governors met before making a final start for their respective provinces, it was agreed, mainly on the arbitration of the pilot and cartographer Juan de la Cosa, but not without much antecedent friction, that the dividing line between the two governments should be the middle of the Gulf of Darien and the Atrato River.

Ojeda sailed from Santo Domingo on November 10, 1509, with three hundred men and twelve brood mares on two ships and two brigantines. Among those who accompanied him was Francisco Pizarro, destined in after years to become famous by his conquest of Peru. An associate of Ojeda's, Martin Fernandez de Enciso, remained behind to follow after the interval necessary to secure more recruits and additional supplies. About ten days later than



SPANISH EXPLORERS

1. Pedrarias Dávila
2. Rodrigo de Bastidas
3. Alonso de Ojeda
4. Vasco Nuñez de Balboa
5. Christopher Columbus
6. Hernando de Soto
7. Francisco Pizarro
8. Bartolomé Colon

Ojeda, Nicuesa sailed with seven vessels, eight hundred men, and six horses.

Ojeda was unfortunate from the first. Contrary to the advice of the sage and experienced Juan de la Cosa, who sailed with him as his lieutenant and alguacil mayor, he went ashore from what is now Cartagena Bay with seventy men, all of whom save himself and one other were killed by the warlike natives. Among those slain was the veteran Juan de la Cosa. Ojeda owed his safety to his bulldog courage, his swiftness of foot, and his smallness of stature, which enabled him to keep well behind his shield. The shield bore the marks of three hundred arrows after the engagement. The two survivors made their way back to the ships, and there they were found by Nicuesa, who put into the same harbor, and gladly joined his forces to those of Ojeda to avenge the fall of their fellow-countrymen. With about four hundred men they attacked the Indians at night and slew great numbers of them. They also secured plenty of booty, of which Nicuesa and his followers received a goodly portion, said to amount to 7,000 castellanos, as their share. Nicuesa then took his departure for Castilla del Oro.

Moving further west, Ojeda set up a fortress and a few houses surrounded by a stockade to be the nucleus of his capital, to which he gave the name of San Sebastian. He wished thus to commemorate his own escape from death by arrows, as the third century martyr of that name survived the shots of the Emperor Diocletian's archers. San Sebastian was the second attempt at establishing a colony on Tierra Firme, or the third, if we count a former somewhat doubtful experiment of Ojeda's at Santa Cruz, in the vicinity of Cape de la Vela and Bahia Honda, in 1502. The other was Columbus's ill-starred fortress at Belen. The situation of the colonists at San Sebastian was far from being an enviable one, for they were surrounded by hostile and very warlike natives, who used poisoned arrows and lost no opportunity of attacking the invaders. In addition, their stores quickly ran out, and there was no means of getting more. When they were reduced to great extremities, however, a ship, stolen by a gang of pirates headed by one Bernardino de Talavera, came opportunely into port with a supply of provisions, and these the colonists purchased with some of the gold they had picked up during their raid on the Indians. Enciso was still looked for in vain, and at length Ojeda decided to go back on the pirates' ship to Santo Domingo and thence bring out relief. He appointed Pizarro his lieutenant in his absence. Before starting he made an agreement that, if he did not return in fifty days, or if Enciso did not arrive within the same period, Pizarro and the other colonists were to be free to take the brigantines and go to Hispaniola or anywhere else they chose.

On the way back to Santo Domingo Ojeda was so domineering that Talavera placed him in chains; but, a storm coming up, he was released on condition that he would pilot the vessel. In spite, however, of his undoubted skill as a navigator, they were shipwrecked on the south coast of Cuba. All the men escaped, and, with Ojeda in command, proceeded to march to the eastern part of the island, in the hope that thence they might find a means of crossing to Hispaniola. They were unfortunate enough to wander into a great morass through which, if we are to believe what has come down to us, they struggled for thirty days, being often up to their armpits in mire. The only place where they could find rest was on the roots of mangrove trees, which grew here and there in the oozy mud. Out of seventy men who floundered into the swamp only thirty-five lived to emerge. These survivors at length came upon a village of friendly Indians, who treated them with great hospitality and kindness, and helped them to reach Cape de la Cruz. From this point they sent a canoe to Jamaica to ask Juan de Esquivel, the governor of that island, for assistance. The position was sufficiently awkward, for in

his heyday Ojeda had once threatened to strike off that official's head. Esquivel, however, like a Christian and a gentleman, responded promptly to the call of humanity, despatched a vessel for the castaways, lavished attentions on Ojeda, and sent him and his attendants faithfully to Santo Domingo. The pirates were in another category, and with them it went harder. Columbus's son, Diego, then governor of Hispaniola with jurisdiction over Jamaica, caused them to be sent in chains to Santo Domingo, where they were convicted on a charge of piracy, and in 1511 Talavera and the ringleaders were hanged.

Enciso having already left for Tierra Firme, Ojeda was now in doleful case. His sun had set. He was without money, friends, or influence, all his attempts to raise another force resulted in failure, and the first governor of Nueva Andalucía never saw his province again. He lingered on in Santo Domingo for some years, and then died. It is believed that, very shortly before the end, he became a Franciscan monk.

In the meantime, Pizarro and his companions at the infant city of San Sebastian were in sorry plight. They were the victims alike of starvation, disease, and the arrows of the Indians. When the fifty days were up, and neither Ojeda nor Enciso appeared, they were by agreement free to leave. Only seventy of them were still alive, and the two remaining brigantines were unable to carry that number. With grim stoicism they waited until death had sufficiently reduced their ranks, and then sailed away for Hispaniola. On the way one of the brigantines suddenly foundered and all on board were lost. Pizarro was on the other vessel, and when he reached Cartagena Bay, he fell in with Enciso, who was engaged in a vain quest for the capital of the new province.

In accordance with the stipulation, though somewhat tardily, Enciso had departed from Santo Domingo. He had one hundred and fifty men, provisions, arms, gunpowder, horses, and dogs. Without his knowledge he had also with him as a stowaway, enclosed in a barrel or rolled up in a sail—it is not certain which—a remarkable man, to wit, Vasco Nuñez de Balboa, who, as we have already seen, sailed with Bastidas to Darien in 1500 and with him had returned to Hispaniola, and who from the time we have now reached was destined to play for a few years an extremely important part in the affairs of Tierra Firme. When Balboa was discovered on board, Enciso threatened to maroon him, but thought better of it when he found that his strangely recruited follower was a really capable and useful man. Arrived at Cartagena, Enciso got on better with the natives than Ojeda had done, and when the remnant of the San Sebastian colonists found him, the Spaniards and the Indians were on friendly terms.

Already before leaving Santo Domingo in 1509 Ojeda had appointed Enciso alcalde mayor, or chief judge, of Nueva Andalucía, and in virtue of this position of authority he now assumed command of the united party. His first exercise of power was to insist, despite the protest of the new arrivals, that all hands should accompany him to San Sebastian. On the way thither, as they were about to enter the Gulf of Darien, their ship was dashed to pieces on the rocks, and all the stores and live stock it contained were lost. The men escaped and succeeded in making their way to San Sebastian, but when they arrived there they found that the whole of the little settlement had been burned down by the natives. Balboa's experience was now of value. He pointed out that he had formerly coasted this country with Bastidas, that on the western shore of the gulf the land was fertile and rich in gold, and that the natives of that district did not use poisoned arrows: therefore, let them cross the gulf. The advice was sound and was acted on, though what means of transportation they had is not apparent. It is likely, however, that Pizarro's brigantine and perhaps the boat of the wrecked ship were available. Things turned out

exactly as Balboa had said. The natives, under their chief Cemaco, were hostile, but for lack of poisoned arrows were easily defeated, and the invaders found great store of gold worked into handsome ornaments. On the site of the captured Indian village Enciso established a new settlement, to which, in fulfillment of a vow, he gave the name of Santa María de la Antigua del Darien, in memory of the great shrine of Santa María de la Antigua in Seville. This settlement is generally referred to simply as Antigua.

Enciso now proceeded to make and administer laws and regulations, but being a cast-iron sort of lawyer who interpreted too narrowly the royal commands from Spain, and wishing to assimilate in advance the conduct of his pioneer colony to that which prevailed in settled communities, he roused an ugly temper among his fellow citizens, and turned them entirely against him. His life even was in great danger; but once more Balboa's common sense and knowledge of geography came to the rescue. He pointed out that, being on the western side of the Gulf of Darien, they were in Nicuesa's territory, and that therefore Enciso had really no authority over them. This was an easy solution of the difficulty. Enciso was deposed, and the people elected from their own body two men, Balboa and Martin Zamudio, to be joint alcaldes, and appointed Valdivia to be one of the regidores. But further disputes soon arose, and a party favorable to Nicuesa was formed. At this juncture two ships with provisions arrived from Hispaniola under the command of a subordinate of Nicuesa's named Rodrigo Enriquez de Colmenares, who was in quest of the governor and province of Castilla del Oro. To the citizens of Antigua Colmenares distributed supplies, and behaved altogether so tactfully that, when he took his departure, they sent with him a deputation of two to invite Nicuesa to Antigua.

When Nicuesa had parted from Ojeda in the harbor of Cartagena, all went well with him for awhile, but he subsequently met with great disasters. He landed in his province at a point to which he gave the name of Puerto de Misas, because Mass was there and then celebrated. Leaving the bulk of his ships and force at Misas in charge of one Cueto, who was a relative of his, Nicuesa continued his western route in search of Veragua and its reputed golden store. He took only a caravel with sixty men and a brigantine with thirty. During a storm which sprang up while they were off the coast of Veragua, the brigantine, commanded by Lope de Olano, disappeared, and Nicuesa, believing that it had perished, still followed the westward track. When, later, he tried to land, his caravel was broken to pieces, but all the crew except one got safely ashore. From the wreck they managed to save the boat and a small supply of provisions, and then set out to march along the shore, the boat in charge of Diego de Ribero and three men going along simultaneously by water, and ferrying the land party at need across unfordable streams or inlets of the sea: Ribero had been with Columbus in 1502 when the admiral discovered this territory, and assured Nicuesa that they had already passed the old settlement of Belen in Veragua. Nicuesa, relying on a chart in his possession made by the Adelantado, Don Bartolomé Colon, refused to believe this, and still continued westward. The result of this conflict of opinion was that Ribero, having brought the whole party on to an island situated probably at the entrance to Chiriqui Bay, left them there, and then turned back eastward in search of Belen. This point he duly made, and there found Olano, who after all had not been lost in the storm, as well as Cueto, who had come up from Misas with the other ships. On the site of the dismantled Belen they had already started to build a new settlement, and they were also searching for gold in the surrounding country; but the circumstances were unpropitious, and they had begun to suffer greatly from floods, disease, and lack of food.

On the arrival of Ribero with intelli-

gence of the whereabouts of Nicuesa, a caravel was at once dispatched to bring him and his companions off. They were in a pitiable condition and had practically abandoned hope, when the welcome sight of the caravel greeted their gaze. Arrived at Belen, Nicuesa immediately threw Olano into chains as a deserter, and then, with not more than half his original force, set sail in an easterly direction and entered the harbor of Puerto Bello. Here several of his men were killed by Indians, and, frightened at the prospect, the harassed mariners still continued eastward in a search of a place to settle. At length they entered a harbor, from which the country seemed fertile and the coast suitable for a fort, and Nicuesa exclaimed: "*Paremos aquí, en el nombre de Dios.*" ("Let us stay here, in the name of God.") The words seemed of good augury: Nombre de Dios they called their settlement, and Nombre de Dios it is to this day. Huts and a blockhouse were quickly run up, and thus was founded the first permanent Spanish settlement in Tierra Firme. But disease lurked there too, deaths were frequent, provisions were scarce, and the remnant of the colony vented their discontent in murmurings and reproaches directed against Nicuesa.

This was the condition of affairs when Colmenares and the ambassadors from Enciso's colony arrived at Nombre de Dios, and invited Nicuesa to go to Antigua to rule.

Nicuesa was none too diplomatic, or perhaps his sufferings had made him forgetful of the requirements of ordinary prudence, and thus, instead of expressions of gratitude for the honor done him and the deference and attention paid him, his talk was all of driving the Ojeda colonists out of Antigua, of deposing their officers, and of forcing them to disgorge their gold. These sentiments, reported in advance at Antigua by the self-same ambassadors who had gone forth with the invitation, caused a complete revulsion of feeling there; and the colonists decided not to receive the governor. Balboa, who was the first to propose this course, appears to have done his best afterwards to save him; but the obstinacy and folly of Nicuesa proved his own undoing. With seventeen of his adherents, the governor of Castilla del Oro was turned adrift in a crazy and leaky ship on March 1, 1511, and from that day he disappears from the page of history forever. What was his ultimate fate, whether he perished by land or sea, or, as was once reported, was eaten by Indians, no one has yet been able with certainty to tell.

CHAPTER III

DISCOVERY OF THE SOUTH SEA

BALBOA IN COMMAND—ENCISO AND ZAMUDIO GO TO SPAIN—BALBOA SUBJUGATES THE SURROUNDING NATIVES—PANCIACO TELLS HIM ABOUT PERU AND THE SOUTH SEA—BALBOA APPOINTED LIEUTENANT IN TIERRA FIRME—DEATH OF VALDIVIA—BALBOA SEEKS THE GOLDEN TEMPLE OF DABAIBA—DEFEATS A CONFEDERATION OF NATIVE CHIEFTAINS—SENDS COLMENARES AND CAICEDO TO SPAIN—HEARS DISQUIETING RUMORS FROM SPAIN—SETS OUT ON HIS MARCH TO THE PACIFIC—OPPOSED BY NATIVE CHIEFTAINS—DISCOVERS THE SOUTH SEA—WADES INTO IT TO TAKE POSSESSION—RETURNS TO ANTIGUA—REPORTS HIS GREAT DISCOVERY TO KING FERDINAND—PROSPERITY OF ANTIGUA.

THE dominant spirit on Tierra Firme was now Vasco Nuñez de Balboa. He made his position more secure, or at least seemed to do so, by allowing Enciso to depart for Spain and inducing Zamudio, his fellow alcalde, to accompany him so as to be on the spot to give the necessary corrective to whatever stories Enciso should tell regarding affairs in the western world. At the same time, Valdivia, the regidor, was sent to Hispaniola to procure much needed supplies for the colony at Antigua, and, by the judicious use of large quantities of gold entrusted to his care, to curry favor for Balboa with Governor Diego Colon, and with Pasamonte, treasurer of the Spanish king at Santo Domingo. The remnant of Nicuesa's garrison at Nombre de Dios was also invited to come to Antigua and settle there, and Colmenares with two brigantines went and fetched them.

Having thus, at the age of about thirty-five, become sole commander and *de facto* governor of Castilla del Oro, Balboa proceeded to reduce the surrounding natives to subjection, and at the same time to collect from them all the gold and treasure he could. For such an enterprise he was well fitted, and he certainly did wonders. Cemaco, whose village the Spaniards were then occupying, was first attacked, and after he and his four hundred men had sustained a severe defeat, he fled from the onslaught of the dreaded white men. The next important chieftain the Spaniards went against was Careta, cacique of Cueva, or Coiba, a district about twenty leagues to the westward of Antigua. Careta received his visitors in a friendly manner, but refused to supply them with a large quantity of maize, on the plea that he had not been able to sow any because of a war in which he had been engaged with Ponca, a neighboring chieftain. They pretended to accept his explanation and apparently took their departure. They returned that night, however, attacked the village, slaughtered many of the inhabitants, took Careta and his family prisoners, and carried them back to Antigua. Balboa knew how to fascinate as well as to conquer. He soothed the ruffled feelings of the captive chieftain so effectually that there and then there was formed between them an offensive and defensive alliance, which was cemented by a union made, according to native usage but not after the Spanish fashion, between Balboa and Careta's beautiful daughter. In accordance with the terms of the treaty, Balboa went with eighty or ninety men to join Careta in an expedition against Ponca, who fled and left his lands to be devastated. On his side, Careta caused corn to be planted, in order to supply his new allies with food.

Comagre, cacique of a district about forty leagues still further west from Antigua, who was reputed to be very wealthy and who ruled over about 10,000 persons and could put 3,000 warriors in the field, was the next

to whom attention was devoted. A friendly meeting was arranged, and Balboa visited the princeling in his palace, which was so large and so well built and had ceilings of wood so beautifully carved as to astonish the white men, who had never before seen anything like it in the Indies. Comagre presented his visitors with 4,000 ounces of gold, and as they were weighing it out, with much wrangling, for distribution between the king of Spain and themselves, Panciaco, the chieftain's eldest son, scornfully dashed down the scales and told them of a country of unbounded wealth, with large cities, in which the people ate and drank out of vessels of gold. This country, he said, was in the south, and was to be reached by sailing over an ocean sea, not more than six days' march distant, on which floated large ships with sails and oars like unto the Spaniards' own. This speech, containing so plain a reference to Peru and the South Sea, of both of which the Spaniards now heard for the first time, was destined to have important results. Comagre and many of his people were baptized as Christians, the chieftain receiving the name of Don Fernando, and the white men returned to Antigua well satisfied with the results of their mission and supplied with something new to ponder.

At Antigua they found that Valdivia, true to his trust, had returned from Hispaniola with a cargo of provisions and a commission to Balboa from Governor Diego Colon appointing him his lieutenant in Tierra Firme and governor of Antigua.

Towards the close of the year (1511) Valdivia was sent back to Hispaniola for more provisions, and with him also went the king's proportion of the gold so far collected, amounting to 15,000 pesos, but the ship, carried out of her course, was wrecked near Yucatan, the gold was lost, and Valdivia and nineteen men barely managed to escape in the boat without sails, oars, or food. In this helpless condition they were tossed about for thirteen days, during which seven of them died in agony from thirst, and the remaining thirteen were cast ashore in Yucatan, where Valdivia and four others were fattened, roasted, and either sacrificed to idols or eaten. The others escaped to Jamancana, but only two of them survived until 1519, when Cortés, on his way to the conquest of Mexico, took one of them, named Gerónimo de Aguilar, with him to act as interpreter. The other, Gonzalo Guerrero, had in the meantime become a leader among the natives, had conformed to their usages and customs even to the extent of having his nose and ears bored for the reception of rings, had married an Indian princess, and therefore politely declined the invitation of Cortés to accompany him.

Ignorant of the fate of Valdivia and of the loss of the king's gold, Balboa was meditating much on the information given him by Panciaco regarding the rich land to the south, and the sea by which it was to be reached. His attention was diverted from this subject for awhile, however, by reports which reached him of the great gold-lined temple of Dabaiba, supposed to be distant thirty leagues to the south of Antigua and to be located on the bank of the Atrato River. To sack a building which promised such valuable loot, he led out, early in 1512, a force of one hundred and fifty men. He discovered no temple, however; but on the way he devastated the territories of two chieftains, Albenameche and Abraiba, and of a third, Abibeiba, whose people dwelt in the tops of trees of immense girth, and returned to Antigua. The three aggrieved chieftains and the lord of the land where the golden temple was supposed to be, goaded on by insult and wrong and actual or threatened invasion, and instigated by the restless Cemaco, cacique of Darien, who had old scores of his own to pay off, formed a great confederation, and placed five thousand men in the field to wipe out once and for all the hated strangers. Their plan, which was to attack Antigua secretly and at night, was well laid, but it was foiled because a brave warned his sister, who was a mistress of Balboa, to be out of the town by a certain

night. The infatuated girl, who had the classic name of Fulvia, told her lover, and Balboa, having received details of the projected assault and of the rendezvous of the hostile forces, became the attacker instead of the attacked, and wrought fell destruction among his foes. Many were killed, many made prisoners, and of the latter, several caciques were hanged. The Darien Indians were thus subjugated.

Uneasy at not having heard from or of Valdivia, Balboa thought of going to Spain to put his case before the king in his own way, but the outcry against the project was so great that he abandoned it. Instead he sent Colmenares and Caicedo, two men in whom he had confidence, and, to aid their eloquence on his behalf, he gave into their charge the king's share of the gold taken since the departure of Valdivia, and commissioned them to be careful to report all that they had heard about the South Sea and the rich country to which it gave access. As it was arranged that the two deputies should call at Santo Domingo on the way to Spain, a handsome present of gold was sent to Pasamonte and a diplomatic letter begging his favor and patronage. It was in October, 1512, that this important embassy started from Antigua.

A feud among his own people, which at first threatened serious consequences, having been put down, Balboa at length felt free to take up in earnest the project of the discovery of the South Sea. He had just now a strong motive to do something extremely notable, for by two vessels which, early in 1513, arrived from Hispaniola bearing provisions, a reinforcement of one hundred and fifty men, and a commission to Balboa as Captain-General of the colony from Pasamonte, there also came letters from Zamudio from Spain conveying disquieting intelligence as to the results of Enciso's reports to the Spanish sovereign. The letters told of the rumored recall of Balboa and the appointment of a new governor of Darien. Some splendid exploit, some signal service, some wonderful discovery, Balboa felt, was now the only thing that could confound his enemies and save him with King Ferdinand. Above all, he must not allow himself to be forestalled by any one else in his enterprise. Whatever he was to do must be done before he was superseded.

Accordingly, on September 1, 1513, he started from Antigua with one hundred and ninety picked men, about 1,000 natives, and a pack of dogs. Going by sea, he landed in Careta's country, and leaving his brigantines and canoes there, he set out on the 6th from the north coast on his march to the Pacific. He made friends with Ponca, and in return received plenty of gold and much valuable information as to easy passes and quickest routes. He was also given a number of reliable guides. Porque, the next chieftain encountered, who was an enemy of Ponca's, ruled in Quarequá, and offered resistance, but the muskets of the Spaniards, their native allies, and, though last not least, the dogs, made short work of the 1,000 warriors of Quarequá. The chieftain and six hundred of his men were killed, many were taken prisoners, and gold in abundance was found alike on the living and on the dead. Ponca's guides were here sent home, and the Quarequá prisoners were pressed into the service. That was on the 24th.

On September 25, Balboa resumed his march, and came to the base of a mountain, from the summit of which the guides assured him a view of the sought-for sea could be obtained. At ten o'clock in the morning he ascended, alone; and when he reached the top, there, before him, lay the South Sea, which he was the first European to behold. His first act was to fall on his knees and thank God for the favor thus vouchsafed him. He then made a signal to his companions, who rushed up the mountain, and saw for themselves the wondrous sight. Then they all joined in singing the *Te Deum*, and Balboa, in the prescribed form, took possession of the sea itself, and all the lands that lay in it, or whose shores it washed, for the crown of Castile. A notary made a written record of the proceedings, and appended to it the names of all the Spaniards present.

Coming down from the mountain and proceeding seaward, Balboa found his passage barred by a cacique named Chiapes; but the muskets, the allies, and the dogs again proved victorious. Chiapes himself escaped, and Balboa, sending after him and using all the charm of manner for which he was noted, made him a firm friend, and received from him a large amount of gold.

On September 29, Balboa, with Chiapes and twenty-six of his own men and a number of Indians, reached the shore. When the incoming tide had covered the sand, Balboa, bearing a banner with a representation of the Virgin and Child on one side and of the arms of Leon and Castile on the other, waded into the sea until it covered his thighs, and in the name of Don Ferdinand and Doña Juana, sovereigns of Castile, of Leon, and of Aragon, took everlasting possession—"until the universal judgment of all mankind"—of those waters and of every shore they touched. It being the feast of St. Michael, he called the nearest water the Gulf of San Miguel, a name it has ever since borne.

From Cocura and Tumaco, local chieftains, Balboa took a heavy toll of gold and pearls. Tumaco and others told him that the land extended indefinitely southward and northward, and that in the south there was a great wealthy nation—the second intimation he received of the existence and riches of Peru. On October 29 he had himself rowed far out into the Gulf of Panama, of which he once more took formal possession in set phrase. To a group of islands where fine pearls were found he gave the name of Islas de las Perlas.

He then decided to return by another route, and after subduing various chieftains on the way and taking heavy booty from them, he arrived in triumph, without the loss of a single man, at Antigua, on January 19, 1514. The feat which he had accomplished, from whatever point of view it is regarded—whether from the smallness of the force, the difficulties surmounted, the shortness of the time, or the results achieved—must be classed as one of the greatest performances of man.

The gold accumulated on this expedition amounted to 40,000 pesos and, after the legal twenty per cent. had been deducted for the king, the rest was fairly divided not only among all the Spanish participants in the march but also those who had remained at Antigua. There were, besides, pearls and cotton cloth. Two hundred and fifty of the purest pearls, in addition to the number required by law, were set aside as a special present to King Ferdinand. In a letter to the monarch written on March 4, 1514, Balboa told of his great exploit. He asked, as was natural enough, that he should be appointed governor of the territory he had discovered, and suggested that ample means should be supplied to him to continue his exploration of the South Sea. The gold, the pearls, the cloth, and the letter were dispatched to Spain about a week after in charge of Pedro de Arbolancha, who arrived at his destination in the following April.

Affairs were now in a fairly settled and peaceful condition in Darien; the natives were either friendly or utterly subdued; and Antigua grew into a prosperous and thriving town. The prospect seemed fair, but it was soon to be disastrously clouded.

CHAPTER IV

BALBOA'S FALL

Enciso Denounces Balboa to the Council of the Indies—Pedro Arias de Ávila Appointed Governor of Castilla del Oro—He Easily Finds Recruits—He Sails for Tierra Firme, 1514—Arrival of Arbolancha in Spain—Change of King Ferdinand's Opinion of Balboa—Balboa Regarded in Spain as a Hero—Instructions Given to the New Governor—Reception of the New Governor at Antigua—Legal Proceedings Against Balboa—He is Fined and Imprisoned—Sufferings of the Newcomers—Balboa Released—Ayora's Campaign—Establishes Santa Cruz—Hurtado Sent in Quest of Ayora—Becerra's Raids—His Death—Destruction of Santa Cruz—Attempts to Reach Dabaiba—Their Failure—Guzman Finds Panama—Expedition of Morales and Pizarro—Unsuccessful Gold-Hunt of Badajoz—Pedrarias Takes the Field—Founds the Fort of Acla—Espinosa Crosses the Isthmus—Defeats Paris, but Fails to Capture the Treasure—Establishes a Station at Panama—Balboa Appointed Adelantado of the South Sea—His Designs Thwarted by Pedrarias—Reconciliation—Balboa Sets Out to Find the Southern Land of Gold—Crosses the Isthmus—Sails Southward Twenty Leagues—Is Betrayed by Gerabito—Balboa's Arrest—Trial—Execution—Character.

IT was most unfortunate for Balboa that Valdivia's ship, which sailed from Antigua late in 1511 with the gold for the king on board, was wrecked and all the cargo lost. Had the gold reached its destination, and the reports of the existence of a great sea and a wealthy nation to the south been received in time, King Ferdinand might have been less willing to listen favorably to the stories detrimental to Balboa which he had already heard and was subsequently to hear from Enciso. Worse still for Balboa was his delay in sending to Spain the news of his actual discovery of the South Sea, and of the confirmation of the rumors as to the rich country to which it gave access. It will be remembered that he arrived back at Antigua from his trans-isthmian march on January 19, 1514, and that it was not until some days after March 4 that Pedro de Arbolancha was dispatched to Spain with the letter containing Balboa's report and the gold, pearls, and cloth for King Ferdinand. Balboa had such strong motives for haste that this delay seems inexplicable. The most plausible theory that can be advanced to account for it is that Balboa, who, during his return from his great discovery, had contracted a fever from hardships and exposure and was actually borne on a litter to the territory of the friendly chief, Comagre, had, after reaching Antigua, a prolonged illness, which prevented him from acting with his usual promptitude. Whatever the explanation, the truth of the adage that delays are dangerous scarcely ever received a more striking illustration. To the dilatoriness in this case may be probably attributed not only Balboa's untimely death but also many of the woes of which Tierra Firme and Peru were subsequently the victims.

Enciso, who, with Zamudio, had gone to Spain in 1511, was violent in his denunciations both of Balboa and of Zamudio to the Council of the Indies, and either Zamudio was lukewarm in the defense of his fellow alcalde, or else, which is probable enough, he had not the ability to make head for an

absent man against the lawyer-like eloquence and powers of presentation of the Bachiller. At all events, the complaints had their effect, for proceedings in the courts were instituted against Balboa, and he was ordered to pay damages to Enciso; and King Ferdinand was so greatly incensed against him that he determined to supersede him by appointing another governor. The arrival of Colmenares and Caicedo in Spain in May, 1513, might be expected to put a different complexion on affairs; but it must be remembered that, while they brought with them gold for the king, they brought only unconfirmed rumors regarding a strange sea, to reach which, through hostile territory, would require a force of a thousand men. This was very different from conveying the news of its actual discovery; and the king's decision remained therefore unaltered. Accordingly on July 27, 1513, he commissioned Pedro Arias de Ávila as the new governor. The territory assigned to him embraced all Ojeda's province of Nueva Andalucía and that portion of Nicuesa's Castilla del Oro which extended westward as far as Veragua. To the united province thus formed was given the name of Castilla Aurifica, a designation, however, which never came into popular use.

Pedro Arias de Ávila, who is sometimes spoken of as Dávila but more generally as Pedrarias, was a soldier with the rank of colonel. He had served with distinction in the African war in 1509, when Spain made her short-lived conquests in Oran. He had led a gay life as a young man and had been a noted tilter in the ring, whence he derived the titles of *El Galan*, or The Gallant, and *El Justador*, or The Jouster. He was now some seventy years of age, but set about his new undertaking with all the ardor of a man in the prime of life.

The persistent attachment of mankind to a numerical figure, once it has been quoted, is very remarkable. We now know of course that Balboa had had only 190 Spaniards with him on his expedition, but the size of the force reported by Colmenares and Caicedo, on the mere estimate of Panciaco, as being necessary to fight its way to the South Sea was accepted as a kind of minimum standard, and caused the number for Pedrarias's undertaking to be fixed at 1,200. On the principle of throwing a sprat to catch a salmon, Ferdinand, despite, or in one sense because of, his love of money, spent 50,000 ducats on the equipment and outfitting of the expedition.

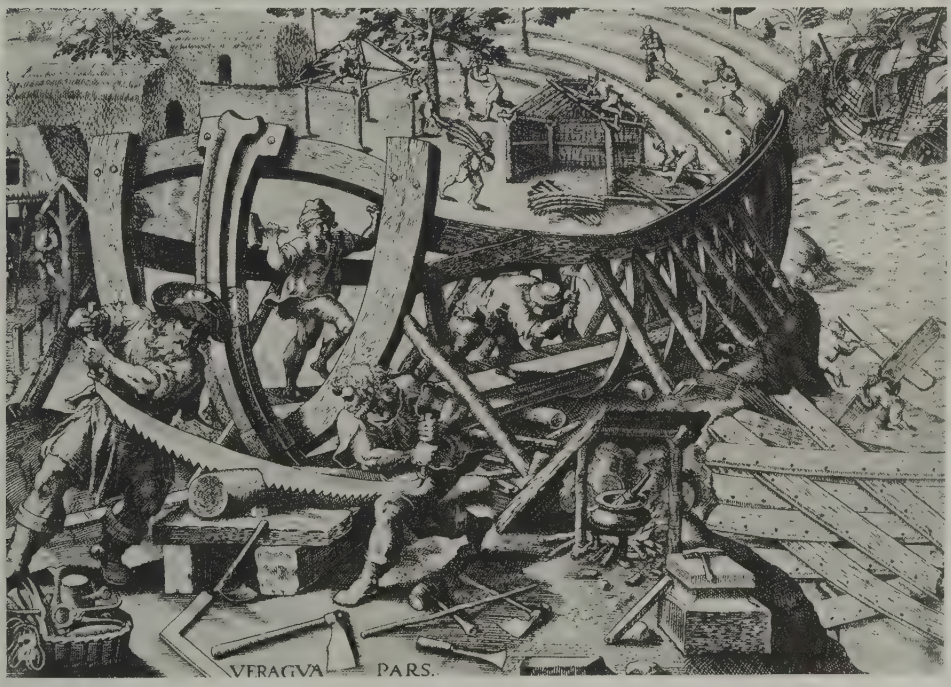
There was no difficulty in finding recruits. The promises of free grants of lands, of distribution of Indian slaves to work them, of ten years' mining privileges subject to a twenty per cent. royalty to the crown, and of free trade in other products, were of themselves sufficiently enticing. To those solid inducements were added the tales told by Balboa's envoys, especially one about a river wherein the natives were wont to fish for gold with nets. No wonder that men saw vistas of conquest and sudden wealth opening out before them. About this time, too, the abandonment by Ferdinand of an expedition to Naples threw thousands of adventurers out of employment, and most of those would have gladly gone with Pedrarias to seek their fortune in the new countries of the west. The result of this combination of circumstances was a rush of volunteers. Pedrarias enrolled three hundred men more than his commission authorized, and still left thousands behind him in sorrowful mood because they were not lucky enough to be selected. After a grand review held on the plaza of Seville, the fleet of eighteen vessels conveying the governor and his men sailed from San Lúcar on April 11, 1514. With him went the licenciado, Gaspar de Espinosa, as alcalde mayor; Juan de Quevedo, as the first bishop of Antigua and Castilla del Oro, accompanied by a band of Franciscan friars; Gonzalo Fernandez de Oviedo y Valdés, as veedor and escribano general; Alonso de la Puente, as treasurer; Diego Marquez, as contador; Juan de Tabira, as factor; the Bachiller Enciso, as alguacil mayor; Juan de Ayora as governor's lieutenant; several captains; and a number of





1. Panciaco tells Balboa of the South Sea—From De Bry, "India Occidentalis," 1594.
2. Balboa takes possession of the Pacific Ocean.





1. Pizarro, Almagro, and Luques at Panama, planning for the Conquest of Peru.
2. Nicuesa rebuilding his Caravel at Veragua—from De Bry, 1594.

others destined to varying degrees of fame, like Hernando de Soto; Pascual de Andagoya; Bernal Díaz del Castillo; and, though last not least, Diego de Almagro, one of the future conquerors of Peru. In the words of one of its members, Pascual de Andagoya, it was the best equipped company that had ever left Spain.

Not many days afterwards Arbolancha's ship came in—but it was too late. When the king saw the rich cotton stuffs, the gold, and the large and lustrous pearls which Balboa had sent him, and when he heard that the western ocean had been already discovered, that it gave access to new territory for profitable exploitation in the south, and that through it the way was now open to the markets of the east, from which by Pope Alexander's line and the treaty of Tordesillas he had been hitherto barred, his feelings towards Balboa naturally underwent a change, and he deeply regretted the large sum he had unnecessarily expended on the equipment of the expedition of Pedrarias. All such regrets were then, however, vain, for Pedrarias was beyond immediate recall, and was well on his way to his distant province. As for Balboa, he became a hero in Spain, where his discoveries were ranked as being almost equal in importance to those of Columbus himself.

The Council of the Indies, guided by the experience it had had of the dealings of earlier conquistadores, had laid down certain very precise and laudable regulations for the guidance of Pedrarias. He was to have always in view the salvation of the Indians and the spread of the Christian religion; to look well after the conduct of his own people, so that they might be to the natives a fruitful example of the good works inspired by faith; to forbid gambling; to visit with condign punishment blasphemy, theft, and murder; and to be himself gentle, honest, and truthful in all his relations with the aborigines. The precept was splendid: the practice, as we shall see, was something very different.

At Antigua, on the rumors of a change of government, men's minds were stirred and rendered extremely uneasy. There were some four hundred and fifty Spaniards in residence there, and it was not beyond the bounds of feasibility for them to resist and prevent the landing of the newcomers; and such a policy found many earnest advocates. But Balboa, who was always loyal to properly constituted authority, lent his voice and powerful influence to councils of peace; and the outcome was that it was decided to extend a hearty welcome to Pedrarias and his fifteen hundred. A gorgeously apparelled advance envoy from the fleet found Balboa in negligé attire, superintending the thatching of a house by natives. Through this envoy a pleasant message was conveyed to those who sent him, and on June 30, 1514, Pedrarias, disembarking at some distance from Antigua, headed a procession to the town. He had on one side his wife, Doña Isabel, and on the other Juan de Quevedo, the bishop, and he was followed by his alcalde mayor, his veedor and escribano general, his treasurer, and other functionaries in order of precedence and rank. The friars chanted the *Te Deum*. The gay garb and fresh complexions of the visitors formed a strong contrast to the well-worn clothes and sun-tanned faces of the older colonists. The meeting of Balboa and Pedrarias left nothing to be desired in point of cordiality. Balboa's manner was, as usual, perfect, and the new governor, dissembling his real feelings, complimented the discoverer of the South Sea on his successes; and all seemed well.

The formal preliminaries of installation over, Pedrarias asked Balboa for a written report of his experiences and performances and of the possibilities of the country. With this request Balboa gladly complied. He devoted two whole days to the drawing up of the document, and with rare single-mindedness omitted nothing that could serve for the future guidance of his chief.

Then, with the needed information in his possession, Pedrarias made a sudden change of front. Suit was entered against Balboa for damages done to Enciso, Nicuesa, and

others, and he was condemned both to fine and imprisonment. More drastic punishment still might have been inflicted but for two reasons: first, both the alcalde mayor and the bishop were friendly to Balboa and used their influence, which was powerful, to save him from the effects of the jealousy of Pedrarias; and, secondly, it seemed probable that the time was not far distant when Balboa's experience and personality would once more prove useful to his compatriots, for the newcomers soon found themselves in a miserable plight. The climate played havoc with their health, a great portion of the provisions they had brought was spoiled and rendered unfit for use, and the influx of so large a body of colonists to a settlement where food was already scanty enough caused a dearth, from which resulted the loss of many lives. Disease and famine combined produced, it is said, the almost incredible number of seven hundred deaths inside of the first three or four months. About a hundred of the colonists, taking alarm, left for Cuba under Bernal Díaz del Castillo and afterwards had a share in the conquest of Mexico. Pedrarias himself sickened and had to retire for a period from Antigua to a more salubrious locality. Things were thus in a very unsatisfactory condition, when a command came from King Ferdinand that posts were to be established across the isthmus from ocean to ocean, that a new settlement was to be established on the Gulf of San Miguel, and that a small fleet was to be equipped and to proceed immediately to explore the South Sea. It was obviously no time to keep a practical man of affairs in captivity, and Balboa was accordingly released in consideration of past and future services.

To Juan de Ayora, the governor's lieutenant, with four hundred men, was entrusted at the outset the duty of setting up the line of posts. The first one was duly erected in the territory of the chief Pocorosa, and was called Santa Cruz. Thereafter, however, Ayora thought more of enriching himself at the expense of the natives than of going on with the business on which he had been sent. Terrible tales were told of his treatment of the Indians. He tortured the caciques in order to extract information regarding their treasures; he hanged them, roasted them alive, threw them living to his dogs, and devised all sorts of torments for them. He did not spare even the chiefs of whom Balboa had previously made friends. Having devastated the country in all directions for several months, he left a garrison of eighty men in Santa Cruz, and proceeded to establish a second post in the territory of Tubanamá. Leaving a garrison there also, he abandoned his task, and hastened back to Antigua with the gold and slaves he had accumulated. To prevent too nice an inquiry into his proceedings, he presented the slaves to those in authority, and then he and his intimates seized a ship, made off with their ill-gotten gold, and Ayora never set foot in Darien again.

Sometime before Ayora's reappearance at Antigua, the governor, alarmed at his protracted absence, sent out Bartolomé Hurtado to find him. Hurtado did discover the missing lieutenant, and then proceeded to organize a campaign of plunder on his own account. He used such effective and prompt measures that he acquired a quantity of gold, brought in a hundred Indians as slaves, and was back in Antigua before the man he went out to seek. He, too, made presents of some of his slaves in the right quarter, and, after the king's proportion of the spoil was taken out, Hurtado and his associates were allowed to keep the remainder.

Another raider of renown was Francisco Becerra. He brought in so much gold and so many captives, and distributed his spoils so lavishly and with such sound judgment, that he was placed in command of a troop of 180 men and sent to Cenú, to avenge the deaths of forty-eight Spaniards who had been cut off there some short time previously. It was a fatal honor. The Indians attacked his party with poisoned arrows, and killed them to a man as they were fording a stream, a native servant of Becerra's being the only one to escape to tell the tale.

The Indians throughout Darien, goaded to madness by the cruelties to which they were subjected and encouraged by their scattered successes, were now very aggressive against the white men. The garrison at Santa Cruz had great difficulty in maintaining its supply of provisions, for every time foraging parties ventured forth they were waylaid and had to fight their way back. When a Spaniard was unfortunate enough to be taken prisoner, the Indians, acting as the Parthian general Surena had done with Marcus Licinius Crassus, put him to death by pouring melted gold down his throat, at the same time shouting, "Eat the gold, Christian! Take your fill of gold!" At length, about six months after its establishment, Pocorosa, aided, if we are to believe Oviedo, by the hitherto friendly Panciaco, attacked and captured Santa Cruz, and put its defenders to death. Not more than five, if so many, escaped.

But despite the dangers by which they were surrounded, the Spaniards did not think of desisting from their quest for gold. In particular, they found the tales of the Golden Temple of Dabaiba an irresistible lure. An expedition of two hundred men under the joint command of Luis Carrillo and Vasco Nuñez de Balboa was sent in canoes up the river Atrato, in June, 1515, to locate this wondrous gold-hoard. The natives bided their time, and at a strategic point rowed out in their own canoes from the screen of foliage on the river bank, and, diving under the Spaniards' boats, overturned them. The attack was so sudden and so fierce that half of the invaders, including Carrillo himself, were drowned or otherwise killed. Balboa then abandoned the enterprise, and brought the survivors back to Antigua.

Another attempt was made on Dabaiba by Juan de Tabira, the factor, and Juan de Birues, the inspector, who took with them one hundred and sixty men in three brigantines and several canoes. Almost as a matter of course, they, too, were attacked by the natives, who used their former tactics; but the brigantines were too heavy to be overturned, and the attack was repulsed. This did not mean ultimate success, however, for a great flood, suddenly rising, swamped some of the vessels, and the two leaders and many of their men were drowned. We now once more meet Francisco Pizarro. He was on this river expedition, and, on the death of the two commanders, was offered the leadership, if he would continue on to Dabaiba; but, thinking discretion the better part of valor, he prudently declined the dangerous honor, and the decimated and disappointed gold-seekers made their way back to Antigua as best they could. Other attempts were subsequently made to reach Dabaiba, but they all resulted in failure, and the Golden Temple, if it ever existed, was never found.

Notwithstanding all manifestations of hostility, however, or other preoccupations, it was the obvious duty of Pedrarias to take steps to complete the line of forts across the isthmus, and it was a duty that could not with impunity be shirked. Accordingly, for that purpose, Captain Antonio Tello de Guzman, at the head of a hundred men, was sent out from Antigua in November, 1515. He arrived at Ayora's second fort just in time to save it from the fate of Santa Cruz, for Meneses, the commander, and his little garrison were closely beleaguered by the enraged natives. Abandoning the fort and taking with him the men he had so opportunely rescued, Guzman continued his route towards the Pacific Ocean. During his progress he appears to have given more attention to collecting gold than to erecting forts. As he advanced, he kept hearing of a place called Panama, and concluded that it must be a town of some size and importance, where loot in plenty could be obtained. He was the first white man to visit the future site of Old Panama; but great was his disappointment when he found that it was only a small fishing village. As a matter of fact, Panama is an Indian word signifying "the place of fish" or "the place abounding in fish." This was the terminus of his journey; and after resting here, and sending

Diego de Albites and eighty men to exact tribute from the neighboring province of Chagre, he turned his steps back to headquarters at Antigua. He had great difficulty in getting there, for Pocorosa, fresh from his sack of Santa Cruz, hung on his flanks and rear, his braves waving in the faces of their foes the blood-stained shirts of the Spaniards they had so recently slain.

Another expedition of eighty men, under Gaspar de Morales and Francisco Pizarro, was dispatched to the Pacific Coast in this same year, but its object was political and predatory rather than administrative. In recognition of Balboa's services, King Ferdinand had appointed him Adelantado of the South Sea and captain-general of the provinces of Coiba and Panama, but Pedrarias, to whom the formal document in the first instance came, being filled with envy of his subordinate and not wishing to see him raised to a rank nearly equal to his own, so arranged matters that the commission did not go into effect for a time. In sending out Morales he had in view the twofold object of belittling as far as he could Balboa's past performances, and of forestalling him in the matter of collecting pearls from the islands of the Pacific, and securing power on the shores of the South Sea. When Morales reached the Pacific Coast, he made war on Dites, who ruled over the Pearl Islands, and the fight would probably have been a prolonged one but for the intervention of two chieftains, who were friendly to the Spaniards, and who told Dites that it was impossible to resist the white men, and that it would be better policy for him to submit. Submit he accordingly did, and, in exchange for a few trinkets, he handed over a number of very large and beautiful pearls. He also became a Christian, and agreed to pay an annual tribute of one hundred marks of pearls. Morales performed the other part of his mission by once more taking possession of the South Sea for the King of Spain, and by changing the name given by Balboa to the principal island of the Pearl Island group fron Isla Rica to Isla de Flores. He succeeded in getting his men and treasure safely back to Antigua, but he had to fight hard all the way, and he left a trail of slaughter behind him. If records are to be credited, he on one occasion killed seven hundred Indians in one hour, and on another he caused eighteen chieftains, called to a friendly council, to be torn to pieces by his dogs.

Another expedition to the South Sea, consisting of one hundred and thirty men under Gonzalo de Badajoz, had at first great success in collecting gold and treasure. Among the chiefs who voluntarily or involuntarily contributed to his takings were Totonagua, Tataracherubi, Natá, Escoria, Biruquete, Taracuri, Panamomé, Tabor, Chirú, and Parizao Pariba, usually called Paris. Paris was wily as well as powerful, and, having by a ruse separated the Spaniards into two parties, he fell upon one of them with four thousand warriors and had almost cut it to pieces before the arrival of the other. The fight then waxed fiercer, but eventually the Spaniards, having lost more than half their number, were forced to abandon all their treasure and take to flight. The remnant reached the South Sea, rested for a month on one of the islands, and then returned by another route, empty-handed, to Antigua.

Pedrarias at length took the field himself. With three hundred men he sailed first to the territory of Cenú, and directed Hurtado with a force of two hundred to effect a landing and burn the village. These orders were duly carried out, many natives were killed, and some taken prisoners. Sail was then set for the territory of Careta. Here was a port named Acla, or "Bones of Men," from which there started a rough trail across the country, and here Pedrarias, intending to erect a new line of posts to the Pacific, began the building of a fort to take the place of destroyed Santa Cruz. While the work was in progress Pedrarias was taken ill with a fever, and he had to be borne back in haste to Antigua.

The command then devolved on Gaspar

de Espinosa, the alcalde mayor, who, leaving Gabriel de Rojas with a small force to complete and garrison the fort, proceeded to cross the isthmus on his own account. He began his march by meting out severe punishment to those subjects of Pocorosa who were thought to have had a hand in the destruction of Santa Cruz. Hanging them, burning them, and blowing them from the mouth of a cannon were the methods he adopted. He then crossed to Panama, collecting treasure as he went. Meeting the unfortunate Badajoz returning as a despoiled spoiler, he learned from him of all the treasure which had been abandoned to Paris, and thinking both that this was a matter worth seeing to and that Paris was likely to prove a formidable opponent, he wrote to Pedrarias urging him to send reinforcements without delay. In the meantime he raided the territories of Chirú and Natá, and secured much gold from both. From Natá he learned that Paris had kept for himself all the treasure which Badajoz had left behind in his headlong flight, and in July, 1516, Espinosa started to attack Paris. His coming was not unexpected, and the alcalde mayor found himself opposed by a powerful combination of native chieftains. A great battle was fought, in which, thanks mainly to their horses and dogs, the Spaniards were victorious. A number of caciques and hundreds of men were slain, but Paris escaped. The next day reinforcements numbering one hundred arrived from Antigua, and a chase after the missing chieftain was begun; but when they came to his village, the bird had flown. The village was in ashes, and Paris and his people, with the much-coveted treasure, had taken refuge in the hill country, where all efforts to locate him resulted in failure. Baffled in their quest, the Spaniards then gave their attention to extensive exploration by land and sea, accompanied of course by the collection of gold. Finally, in 1517, Espinosa having established at Panama the southern station of the line of posts that was to cross the isthmus, and having left Hernando Ponce de Leon with a small garrison to defend it, returned to Antigua with 8,000 pesos of gold and 2,000 slaves.

While all these things were going on, Balboa, who had been made aware of his appointment as Adelantado of the South Sea, and who was anxious to be up and doing in that capacity, sent secretly to Cuba to secure men, arms, and provisions for an expedition. His messenger brought back seventy men and ample stores, and put into a small bay a few miles from Antigua. Pedrarias, hearing of the project, had Balboa arrested and confined in a large iron cage. Then Bishop Quevedo intervened and patched up a truce between the two. Balboa agreed to abate some of his pretensions as Adelantado, to put away his Indian wife, and to marry the eldest daughter of Pedrarias. This young lady was then in a convent in Spain, but the affair was arranged for her by her parents. Balboa was now free to set about the execution of his cherished design of the thorough exploration of the South Sea. He first (1516) went to Acla, where he found that the fort erected by Pedrarias had been destroyed by the Indians, and its commander and some of his men killed. Balboa immediately laid out a new settlement, and had already established there some form of civic government when Espinosa arrived on his return from his conquering raids. Balboa accompanied him to Antigua, and induced two hundred of the alcalde mayor's tried men to attach themselves to the force that he was raising. At Acla, in 1517, he collected materials for four brigantines to be used on the South Sea, and these materials he caused to be carried by an immense number of natives for twenty-two leagues to the headwaters of the Rio de las Balsas. It was a tremendous undertaking; every one was hard driven; provisions were scarce; and from 500 to 2,000 Indians are said to have perished in the unaccustomed work of transportation. When the parts came to be put together, it was found that much of the timber was worm-eaten and could not be used; a flood, which was so great that the

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men had to climb trees to escape it, carried away more; and altogether it was possible to construct only two brigantines. In these, however, Balboa and his party sailed down the river into the Gulf of San Miguel and out into the Pacific.

It was a great feat, which one of the old chroniclers says no one but Balboa could have accomplished. For all that, we are inclined to wonder why at least the timber for the brigantines could not have been procured as easily on the shores of the Pacific as on the shores of the Atlantic, especially as we are told that, while the explorers were resting among the Pearl Islands, they constructed two more brigantines.

At all events, Balboa had now four vessels in the South Sea, and in them he set out with a hundred picked men to look for the country where the people ate and drank from vessels of gold. They had sailed about twenty leagues when they ran into a school of whales—an untoward incident that so frightened everybody that they incontinently put into a convenient harbor on the mainland. The cacique here, who was named Chuchaumá, was hostile, and made an attack on the Spaniards, but he and his men were beaten off with great loss. Balboa wished to continue his southward journey, but encountered winds so adverse that he was perforce obliged to return to the Pearl Islands.

Here he received disquieting intelligence. A rumor was afloat that in consequence of complaints made by Oviedo, the veedor and escribano general, who had gone to Spain in 1515, Pedrarias was to be superseded by a new governor. Such a change would fit in badly with Balboa's plans, as he was afraid that, under a new régime, he would not be allowed to continue his quest, and that thus the fruit of all his precedent labors would be lost. He said as much to his friends, Valderrábano, the notary, and Rodrigo Perez, a priest; and, unluckily, the conversation was partly overheard by a sentinel, who construed what reached him to mean that Balboa proposed to fight for his own hand, and to throw off allegiance to Pedrarias or any other governor who might stand in the way of his great ambition.

There is no doubt that Balboa acted imprudently in talking as he did. Worse still was a stupid little plot which he concocted, and which eventually proved his undoing. As he needed some pitch and iron for his brigantines, he dispatched four men to Acla to fetch them, charging them at the same time to learn how the matter stood regarding the change of governors. If the new one had arrived, they were to return at once and hand him a forged commission, which he could use to induce his command to accompany him without fear or misgiving on the southward journey he had in contemplation. If Pedrarias were still in office, they were simply to secure the iron and pitch, and no document would be necessary. Now, one of those messengers, named Andrés Garabito, was jealous of the favors Balboa had received from Careta's beautiful daughter, and had already sent word to Pedrarias from the Rio de las Balsas that it was Balboa's intention, once he reached the South Sea, to act independently of the governor. To make the old man's resentment all the deeper, Garabito had added that the Adelantado was so smitten with the charms of his dusky mistress that he would never wed the governor's daughter. At Acla it was soon learned that, even if a new governor had been appointed, he had not yet arrived. Then Garabito saw his way plain to ruin the man who was his successful rival in love. In public he talked in a mysterious way and threw out sundry hints as to what Balboa and his friends, himself included, intended to do. This action led to his arrest, as he had planned, and he then told the whole story of the plot. Confirmation of a portion of it was soon obtained from the eavesdropping sentinel; and Pedrarias, with fate thus playing into his hands, determined that Balboa should die.

At this juncture he received a letter from Balboa asking for an extension of time, as the eighteen months allowed him had now elapsed. At the same time Balboa wrote

to one Fernando de Arguëllo, a notary, who had embarked some capital in his expedition, urging him to use his influence to secure the time extension asked for. To Arguëllo Pedrarias would make no promise, and the notary thereupon wrote to that effect to Balboa and simultaneously counselled him to sail at once for the rich southland. This letter never reached its destination, for Pedrarias took care to intercept it and master its contents. Pedrarias then acted with great astuteness and deliberation. He first arrested Arguëllo and others of Balboa's friends. Then, to get the Adelantado away from his little army of three hundred, who might have made trouble, he wrote in a very friendly spirit a reply to his letter, and asked him to come to Acla for a conference. The unsuspecting Balboa at once complied with the request. Leaving Francisco Compañon in command at the Pearl Islands, he set out for Acla. On the way he was warned by the messengers who accompanied him of the danger that threatened him, but, with characteristic trust and, let it be added, obstinacy, he refused to credit their statements, and so went forward to his doom. When he had compassed more than half the journey, he was met by a force sent out to arrest him under the command of Francisco Pizarro. It was the irony of fate that this base-born and unlettered man should have been chosen to make prisoner of a hidalgo and conquistador of the standing of Balboa. "What is this, Francisco Pizarro?" said Balboa; "you were not wont to come out in this fashion to receive me." It was stern fact, however, and the discoverer and Adelantado of the South Sea was taken to Acla in irons by the subordinate who was destined to supplant his former commander in the glory of the discovery and conquest of Peru.

Balboa was speedily brought to trial. He was accused of being a traitor and of making usurpation on the rights of the crown, and the former accusations regarding Enciso and Nicuesa were also brought up against him. His pleas of innocence were of no avail, and Espinosa, as alcalde mayor, found him guilty and liable to the penalty of death; but recommended him to mercy on account of his great public services. The recommendation, however, fell on deaf ears: Pedrarias was not to be balked of his prey. It was unfortunate for Balboa that at this time both Oviedo and Bishop Quevedo were in Spain, for the claim made by the condemned man to the right of appeal to the Council of the Indies and, failing that, to the Jeronimite Fathers at Santo Domingo, although strongly urged by Espinosa, was rejected by Pedrarias, who ordered an immediate execution. "Since he has sinned," said the hoary old reprobate, "let him die for it." Accordingly, on the plaza of Acla, Balboa and his four friends, Andrés de Valderrábano, Hernan Muñoz, Fernando de Arguëllo, and Luis Botello, after receiving the last rites of their church, were straightway beheaded on April 16, 1517. Pedrarias viewed the bloody spectacle from behind a screen of reeds. Balboa's head was stuck on a pole in the plaza and there allowed to wither away.

So perished, in his forty-second year, the noblest and perhaps the ablest of the Spanish conquistadores. He had proved his bravery on many a hard-fought field and his judgment in many a soul-trying crisis. His relations with the Indians of Tierra Firme, although sometimes harsh, yet showed that tact in dealing with men, and especially with conquered foes, which is one of the genuine marks of a great statesman. He had made mistakes, it is true; but they were mainly the mistakes to which a generous nature is liable. Whatever his mistakes, and whatever his vices—and they appear to have been few—they are forgotten in the glory of his positive achievements and in the tragic ending to a life apparently so full of the promise of greater things to come. On the page of history a bright halo must forever encircle the name of the famous but unfortunate Vasco Nuñez de Balboa.

CHAPTER V

SPANISH RULE ON THE ISTHMUS

Pedrarias Superseded—Lope de Sosa Appointed Governor of Castilla del Oro—Pedrarias Leaves Antigua—Founds Panama—Espinosa Secures Paris's Gold—Diego de Albites—His Career—He Re-founds Nombre de Dios—Death of Lope de Sosa—Pedrarias Still Governor—Oviedo's Rule in Antigua—Its Failure—Antigua Abandoned and Burned—Uprise of Panama—Exploration by Pascual de Andagoya—Urracá Defeats Espinosa and Pizarro—Espinosa Founds Natá—Establishment of Alanje—Gil Gonzalez Dávila—His Search for the Moluccas—He Discovers Lake Nicaragua—He Names the Gulf of Fonseca—His Great Success—His Northern Explorations—He Goes to Mexico—His Return to Spain—His Death—Activity of Oviedo—Pedrarias Again Superseded—Pedro de Los Rios Appointed Governor of Castilla del Oro—Pedrarias Seizes Nicaragua—Foundation of Granada and Leon—Córdoba's Rebellion—His Negotiations With Cortés—Pedrarias Leaves Panama for Nicaragua—Execution of Córdoba—Pedrarias's Conflict With Saavedra—Arrival of Pedro de los Rios—Pedrarias Tried and Acquitted—Pedrarias Appointed Governor of Nicaragua—Rivalry of Salcedo—Deposition of Salcedo—Exploration of the San Juan River—Pedrarias Deals in Slaves—Holds Gladiatorial Contests—Depletion of the Native Population—Pedrarias Secures Territory in Honduras—Fails in San Salvador—Sells His Interest in Peru—His Death—His Character.

THE reports made both by Oviedo, the veedor, who had gone back to Spain in October, 1515, and by Bishop Quevedo, who had also returned, were extremely adverse to Pedrarias, and it was determined by the Council of the Indies to supersede him. King Ferdinand died on January 23, 1516, and to his successor, his young grandson, Carlos I, afterwards destined to achieve great fame as the Emperor Charles V, fell the duty of appointing the new governor. He selected for the onerous post Lope de Sosa, who was then acting governor of the Canary Islands; but apparently de Sosa was in no hurry to take over his new command, for he did not arrive at Antigua until May, 1520.

In the meantime, Pedrarias, uneasy in mind as to what the rumored change might portend for himself, conceived the idea of becoming ruler on the shore of the South Sea, where he hoped to be independent of the new governor of Castilla del Oro. With this object in view he proposed to his cabildo or council that the capital should be transferred from its then site to a new one on the other side of the isthmus. There were many reasons why this proposal was unlikely to find favor, not the least among them being the fact that in 1515 metropolitan privileges had been granted to Antigua, thus making it the first European city on the American continent, as well as the seat of the first bishopric. To abandon such a settlement and transfer its privileges elsewhere seemed little short of desecration, as well as being wholly impracticable; and the proposal was accordingly rejected.

Thereupon Pedrarias decided to go to Panama on his own account. With all the valuables that could be amassed and as many troops as could be induced to accompany them, the governor and his alcalde



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For this cause they assembled all the Ocean the South Sea, which lyeth on the other side of the East *Indies*. shooting a great part of it self to the North, as all the coast of new *Spaine*, *Nuangna Guatimala* and *Panama*. They say, that he that first discovered this Sea, was called *Blascommes* of *Bilbo*, the which he did view part where we now call *Mame Land*, where it growes narrow, and the two Seas approach to neere the one to the other, that there is but seven leagues of distance: for although they make the way eighteene from *Nombre de Dios* to *Panama*, yet is it with turning to seeke the commodities of the way, but drawing a streight line, the one Sea shall not be found more distant from the other. Some have attempted and propounded to cut through this passage of seven leagues, and to joyne one Sea to the other, to make the passage from *Peru* more commodious and easie, for that these eighteene leagues of Land betwixt *Nombre de Dios* and *Panama*, is more painefull and chargeable then 2000. by Sea, whereupon some would say, it were a meanes to drowne the Land, one Sea being lower then another. As in times past we have it written, that for the same consideration, they gave over the enterprize to winne the red Sea into *Nylus* in the time of King *Sesostris*, and since, in the Empire of the *Othomans*. But for my part, I will not dispute and propound for vaine, although this inconvenience should not happen, the which I will not hold for assured. I believe there is no humaine power able to undo and breake downe such strong and impenetrable Mountaines, which God hath placed betwixt the two Seas, and hath made them most hard Rockes, to withstand the rage of two Seas. And although it were possible to men, yet in my opinion they should feare the judgement of God, in seeking to correct the workes, which the Creator by his great providence hath ordained and disposed in the framing of this universall world.

Terra firma.

Streight of Land betwixt North & South Seas.

Herodotus.

Isaias.

3 Leaving this discourse of opening the Land, and joyning both Seas together, there is yet

1 *Emperor Charles V.* by *Titian*. Pinacoteca, Munich.
2 *Philip II.* by *Titian*. Prado, Madrid.
3 Extract from Acosta's History of Peruvian Platinum, 1625.

mayor, Espinosa, set out, and having reached the south coast in safety in January, 1519, once more took formal possession of mainland, islands, and ocean. They found that Hernando Ponce de Leon, whom, as will be remembered, Espinosa had left in command at Panama in 1517, had abandoned the post, and that Francisco de Compañon was still at the Pearl Islands, where Balboa had placed him; but this proved no bar to the designs the governor had formed, and accordingly, on August 15, 1519, Pedrarias officially founded the town of Panama, in the name and on behalf of Doña Juana the queen and Don Carlos her son. The surrounding lands he divided among his 400 followers, with permission to till them by means of any Indian slaves they might succeed in capturing.

Espinosa had by no means forgotten the great quantity of gold which the cacique Paris had retaken from Badajoz and had managed to retain, and, as soon as arrangements could be effected for that purpose, he set out in quest of it. Taking with him 150 men, he sailed to the west as far as that chieftain's territory, ascended the river in canoes, and found that Paris had recently died and that his son Cutara had succeeded to his position. The village was attacked and plundered, but no gold was discovered until a search was made around the body of the dead chief, then lying in state, and there gold to the value of 40,000 castellanos was obtained. Espinosa had further luck, for he succeeded in securing from a chieftain named Biruquete a large quantity of maize. With these two valuable commodities in his possession he went back to Panama, where half the treasure was buried, and Pedrarias and Espinosa returned to Antigua with the other half.

By one of those lucky chances which appear so remarkable to the student of history, the new town founded by Pedrarias obtained an importance which at its beginning no one could have foreseen. Among the Spaniards who had accompanied Pedrarias from Spain to Tierra Firme there was a captain named Diego de Albites, who at one time seemed destined to achieve great reputation as a conquistador. He had been with Captain Guzman in 1515–1516, when that commander had discovered the original fishing village of Panama; he had been prominent in the ravages and lootings committed on that celebrated march; he had been one of those who helped to conduct Guzman's disastrous retreat, through the disturbed Indian country, back to Antigua; he had been in the thick of the fighting in 1516, when Espinosa worsted Paris; he had helped to establish at Panama in 1517 the southern station of the line of posts which was to cross the isthmus; and in the same year he had accompanied Espinosa when he returned, laden with booty but half famished, to Antigua. Albites had thus become a seasoned fighter. A little later he went on a raiding expedition along the north coast from Chagre to Veragua, and displayed so much ability in collecting gold and captives that the cabildo gave him a license to effect settlements in Veragua. Accordingly, in 1519, he sailed from Antigua to carry out his grand scheme of colonization, but when he had reached Punta Manzanillo, his vessel sprang a leak, and he put back to the island of Bastimentos, on which he and his men had just time to land before the ship went down. This disaster put an end to the Veragua scheme, but amends were made in another direction. Ferried across to the mainland in canoes by the natives, Albites and his party, very much against the wish of Pedrarias, who was just then at loggerheads with the Cabildo at Antigua and who looked with anything but favor on a possible rival to Panama, refounded Nombre de Dios, which had lain derelict since its abandonment by the remnant of Nicuesa's force. This foundation proved lasting, and for a long period Nombre de Dios remained the northern terminus of the trans-isthmian trade. Nombre de Dios and Panama are exactly opposite each other, and gradually there was built between them a paved

roadway, known as the Camino Real, over which, after the discovery of Peru, passed the plate-trains northward, and in both directions all other articles of merchandise. Panama thus became an important entrepôt on the Pacific side. In fact, around the towns of Panama and Nombre de Dios centers, to a large extent, the history of Tierra Firme for nearly sixty years.

Fortune thus played into the hands of Pedrarias. It befriended him very materially in another way. It appears that he made many journeys between Panama and Antigua. On one occasion, in May, 1520, when he happened to be at Antigua, Lope de Sosa, the new governor, arrived with 300 men to assume his office. Pedrarias was preparing to receive his successor with due pomp and formality, when word reached him that de Sosa, who had gone to his cabin on board ship to dress before disembarking, had suddenly died. This unexpected event gave Pedrarias a fresh lease of power. He once more proposed the removal of the capital to Panama, but, principally owing to the opposition of Oviedo, who had returned as regidor perpetuo, the proposal was once more rejected, and Pedrarias betook himself to his South Sea settlement, leaving to Oviedo the increasingly difficult task of ruling in Antigua.

Oviedo had magnificent ideas and high ideals, and he started in on his new and arduous duties with a will. He opened mines, built ships, traded with the natives, established peaceful relations with them, and, when they were not amenable to that kind of treatment, he knew how to use punitive measures effectually. His principal difficulty at first was with his fellow-countrymen. He was a reformer, and the colony was not ripe for reforms. Hence his attempts at putting down gambling, blasphemy, the keeping of mistresses, and the trading in Indian children, resulted in dissatisfaction and disaffection. Under so stern a régime the colony weakened, and, as it weakened, its native foes grew stronger and bolder. Finally Pedrarias took a hand, deposed Oviedo, and appointed the Bachiller Corral to succeed him as head of the Cabildo. Oviedo, in virtue of his commission of regidor perpetuo, then took his seat as an ordinary member of the Council. In such a state of affairs there could not be much unity of purpose in municipal government. Things were assuming an ugly look, and the people of Antigua, alarmed at the prospect, decided to send Oviedo to present their grievances at the court of Spain. Before sailing he brought charges against Pedrarias, and had a narrow escape from being assassinated. A second unsuccessful attempt to kill him brought home the realization that the sooner he left the better it would be for his safety, and he sailed away on July 3, 1523. With his departure the life went out of Antigua. The people gradually abandoned it for Panama and Nombre de Dios. Finally, only one colonist, Diego Ribero, was left, and in September, 1524, he and all his family were slain by the Indians. At the same time the town was burned, and so effectually did it disappear, and so thoroughly did nature assert its sway, that at present no one can with certainty say what was the exact site of Antigua. The natives reassumed control of the district, and from that day to this the white man has been jealously excluded from the eastern part of Darien.

The downfall of Antigua was the uprise of Panama. Founded officially on August 15, 1519, Panama was created a city, and given a coat of arms, and had many privileges conferred on it, by royal decree of September 15, 1521. The Episcopal See was transferred from Antigua to Panama in 1524. In every official as well as practical way Panama became the capital of Tierra Firme. In particular, it became the basis for exploration. It was in Panama that the expeditions for the conquest of Peru were equipped, and it was from Panama that much of the remaining territory of Central America was discovered and settled.

Pascual de Andagoya, who was one of

the first regidores, or aldermen, of Panama, was appointed, in 1522, Inspector General of the Indies. In that capacity he at first turned his attention to the exploration of the country that lay eastward of the Gulf of San Miguel. He had some initial success; but eventually, owing to an illness brought on by the overturning of his canoe and a consequent wetting, he gave up and returned to Panama. He brought back confirmation of the reports that placed a rich nation to the south, and Juan Basuto was empowered to follow up Andagoya's lead; but Basuto died suddenly, and the enterprise was abandoned until Pizarro took it up.

Pedrarias himself gave his attention more to the exploration of the country to the west and north of his capital than to that which lay to the south and east. He sent out an expedition under Espinosa and Pizarro against a chieftain of Veragua, named Urracá, but the powerful cacique and his fierce warriors beat off the invaders, who had to fight hard to make good their retreat. Despite this reverse, however, Espinosa succeeded in founding on the site of an Indian village, which Alonzo Perez de la Rua and Gonzalo de Badajoz had taken and looted in 1515 and which he had himself treated similarly in 1516, the colony of Natá which, though threatened frequently at first by Urracá, managed ultimately to hold its own. Destroyed by the natives in 1529, it was reëstablished by Pedrarias under a new name, that of Santiago de los Caballeros, but, as has happened in other cases, it is under the old title that it survived and survives to the present day. Urracá continued to give trouble, but, being decoyed into Natá under promise of safety, he was there seized and sent in irons to Nombre de Dios to be shipped to Spain, but he contrived to escape, and made his way back to his own people, among whom, to his dying day, he remained the uncompromising foe of the hated white men.

Another settlement made in 1521, and still existing, is Alanje, a contraction or corruption of Santiago al Angel. Known at one time as Chiriqui, this town was the original capital of the province of that name, a distinction now enjoyed by the city of David. The farthest settlement made in Veragua, in the direction of Nicaragua, Alanje was founded by Benito Hurtado and was unmolested for about two years, when the natives, smarting under many wrongs, were goaded into a revolt, which was not put down without much trouble. Alanje appears to have been refounded in 1591 by the maestre de campo, Captain Pedro de Montilla Añasco. Hurtado also founded in Chiriqui the little town of Fonseca.

Acting under royal order issued at Barcelona on June 18, 1519, Gil Gonzalez Dávila, contador of Hispaniola, who, despite the similarity of surname, was no relative of Pedrarias, undertook, in cooperation with Andrés Niño, a pilot, an expedition, the object of which was to discover the Moluccas or Spice Islands by way of the South Sea. Many obstacles were placed in his way by Pedrarias, and it was not until January 21, 1522, that Gil Gonzalez made a start from Panama. He did not reach the Moluccas, but his seaforces explored the southern and western shores of the countries now known as Costa Rica, Nicaragua, Honduras, Salvador, and perhaps Guatemala. He himself discovered and took possession of Lake Nicaragua, which he called Mar Dulce; he gave its name to the Gulf of Fonseca; he converted 32,000 Indians; he returned to Panama on June 25, 1523, with 112,000 pesos of gold; and he did all this without any fighting and without losing a man. What was equally difficult, perhaps, he got his gold safely away from Pedrarias, made for Nombre de Dios, and thence set sail for Hispaniola. From Hispaniola he dispatched his treasurer, Antonio de Cereceda, to Spain with a report to the King and a map delineating the west coast of Tierra Firme from Panama to the Gulf of Fonseca. He next proceeded to investigate from the northern side the lands he had discovered,

and while thus engaged he fell in first, at Toreba, with one section of a party of intruders sent out by Pedrarias, and defeated and despoiled them, and then with the second force of troops that Cortés had sent down from Mexico. With these latter he went to Mexico, where he had a narrow escape from execution at the hands of Cortés's enemies, who were then in power. Gil Gonzalez was finally sent to Spain for trial, and, surviving a shipwreck, he reached Seville, and, released on parole, he retired to his home at Ávila, where he died on April 26, 1526.

In the meantime Oviedo was not unmindful of the many grudges he had against Pedrarias. When he left Antigua, he sailed to Cuba and afterwards to Hispaniola, whence he accompanied the governor, Diego Colon, to Seville, arriving there in November, 1523. He then entered his complaints on behalf of Antigua against Pedrarias, whose recall he insistently demanded. It was not by any means all plain sailing, for Pedrarias's wife and the Bachiller Corral were on the spot, and, using every artifice to thwart and baffle the veedor, they involved him in lengthy litigation. He finally gained his ends, however, and Pedro de los Rios was appointed governor of Castilla del Oro in room of Pedrarias.

Pedrarias, aware of what was going on, set about to prepare, for a second time, a safe place of retreat. For this purpose the recent discoveries of Gil Gonzalez seemed to offer exactly what was desired. Accordingly, in 1524, Pedrarias dispatched a force under Hernandez de Córdoba, whom he appointed his lieutenant in Nicaragua. With Córdoba went the captains Gabriel de Rojas, Francisco Compañon, and Hernando de Soto. It was de Soto whom Gil Gonzalez defeated at Toreba, taking from him 130,000 castellanos. Córdoba founded the cities of Granada and Leon and explored the Mar Dulce, and then conceived the idea of shaking off his allegiance to Pedrarias and becoming independent governor of Nicaragua. To this proceeding Compañon and de Soto objected, and there ensued between the rival commanders a battle of which Córdoba had the better, and de Soto with only ten followers retreated to Natá, whence he sent in haste to his chief a report of the happenings in Nicaragua. By this time Cortés, having finished his celebrated southward march, was at Trujillo in Honduras, and to him Córdoba offered Nicaragua on condition that he himself should continue to hold the command as Cortés's lieutenant. The negotiations were not completed when Cortés was suddenly recalled to Mexico by the posture of affairs there, and he took his departure from Trujillo on April 25, 1526, leaving Saavedra as his deputy in Honduras.

De Soto's report decided Pedrarias as to the action he should take. He knew that he would soon be relieved as governor of Castilla del Oro by Pedro de los Rios, and the time seemed opportune to make sure of his hold on the territory which his rebellious subordinate was trying to wrest from him. Panama and Natá were practically stripped of men, because nearly all had accompanied Pizarro and Almagro on their first voyage to Peru, but Pedrarias levied what forces he could on Acla and Nombre de Dios, and also impressed a number of Indians into his service. With the troops thus secured Pedrarias sailed from Panama in January, 1526. To insure undivided possession of Nicaragua to himself, his first act was to cause Córdoba to be decapitated. Eager for even more territory, he then proceeded to lay hands on Honduras. Here he encountered Cortés's lieutenant, Saavedra, and there took place an indecisive contest; but the natives, rising to the occasion and taking advantage of the feuds among the white men, revolted en masse and drove back both bands of invaders.

In August of that year, 1526, Pedro de los Rios arrived as governor, and sequestered Pedrarias's property, on hearing which the latter returned to Panama, where he arrived on February 3, 1527, to meet

whatever charges might be preferred against him. Charges and claims were made, but the wily old official had left many of his enemies behind in Nicaragua, and besides was an adept in manipulating evidence, and he came off with flying colors, and his property was given back to him. Not only that, but, Gil Gonzalez being now dead, Pedrarias was officially appointed *de jure*, as he was already *de facto*, governor of Nicaragua. A rival candidate for that office appeared in the person of Diego Lopez de Salcedo, who in 1525 had been appointed governor of Honduras by Charles V. Salcedo drove Saavedra from Trujillo, and then proceeded to annex Nicaragua. He was received by the settlers at Leon, and took the oath of office as governor on May 7, 1527. His position was challenged by Pedro de los Rios, who claimed Nicaragua as portion of his own province of Castilla del Oro, but he was unable to make headway against Salcedo, who, backed by the colonists of Leon, gave him three days to quit that portion of the country. Salcedo, however, soon became unpopular, and there was in Leon a faction which favored Pedrarias, so that when the latter appeared at the settlement in March, 1528, Salcedo was deposed and imprisoned, and Pedrarias ruled in his stead.

One of the great characteristics of Pedrarias was his indomitable energy, which advancing years seemed in no way to abate. In his new bailiwick he at once entered upon a most active career of colonization, trading in native slaves, and extension of his territory. Two of his officers, Martin Estete and Gabriel de Rojas, with 150 men, he dispatched to explore the San Juan River, and they marched down its left bank to the shores of the Caribbean Sea, and then started to explore the coast northward. In the course of their investigations they discovered mines near Cape Gracias á Dios and founded a colony in the vicinity to work them. They also sent the natives they captured to Pedrarias at Leon, and he in turn sent them by the shipload to be sold in the slave-mart which he had previously set going in Panama. Some few of the strongest ones he kept for the cruel sport of making them fight with the dreaded dogs. The issue of such contests was never in doubt, for when a native had repulsed the young dogs with his stick and begun to think he might save his life, old and fierce animals were set upon him and pulled him down and ate him. The result of this slave-making and slave-baiting policy was to deplete the population—a depletion which was still further hastened by a self-denying ordinance among the native women, who decided not to bring into the world children destined for treatment so barbarous and uses so vile.

With his schemes of territorial aggrandizement Pedrarias was not quite so successful. He did indeed manage to take some territory in Honduras from Salcedo, but when he sent Estete and Rojas to make a settlement in the country now known as Salvador, they fell foul of Pedro de Alvarado, who was holding that region for Cortés, and who quickly drove the newcomers out.

One great sorrow Pedrarias was spared. In consideration of his favor while ruling in Panama, he had, in 1524, been assigned a fourth interest in the expedition to Peru, but this he sold, in 1527, to Diego de Almagro and his associates for 1,000 pesos de oro, and so cut himself and his heirs out of the enormous profits which would have accrued from the third and successful voyage which Pizarro made from Panama in January, 1531. He did not live long enough to see or hear of the shiploads of silver and gold that came up to Panama from the mines of Peru to be carried thence by pack trains over the Camino Real to Nombre de Dios for conveyance to Spain. Had this occurred during his lifetime, it would surely have broken his avaricious heart.

He had, however, troubles enough to contend with. He held sway, indeed, in Nicaragua until his death, but his closing years were vexed with charges of peculation and abuse of authority, in the midst of

which the end came. When he was at least eighty-eight years old, Pedrarias died on March 6, 1531, and was buried with considerable pomp in the church at Leon. He left behind him a terrible reputation. If Oviedo's statement is correct, Pedrarias, during his eighteen years' residence in Central America, was responsible for the death of 2,000,000 Indians, and thus fully deserved the title of *Furor Domini*, or wrath of the Lord, which was given him by one of the old Spanish monks.

CHAPTER VI

TURMOIL IN THE COLONIES

GROWTH OF PANAMA—FOUNDATION OF CARTAGENA—REËSTABLISHMENT OF SAN SEBASTIAN—EASTERN BOUNDARY OF CASTILLA DEL ORO FIXED—ATTEMPTS TO COLONIZE VERAGUA—CONCEPCION FOUNDED BY FELIPE GUTIERREZ—SAD PLIGHT OF THE COLONISTS—ABANDONMENT OF CONCEPCION—VERAGUA BECOMES CROWN LAND—ITS RAPID SETTLEMENT—CONFLICT BETWEEN NICARAGUA AND CASTILLA DEL ORO FOR TERRITORY—ATTEMPT TO COLONIZE NUEVA CARTAGO OR COSTA RICA—ITS FAILURE—DEATH OF DIEGO GUTIERREZ—BARTOLOMÉ DE LAS CASAS—HIS CAREER—HIS WRITINGS CAUSE CHARLES V TO PROMULGATE THE NEW LAWS—CONSEQUENT DISSATISFACTION IN AMERICA—HIGH-HANDED PROCEEDINGS OF VELA—GONZALO PIZARRO REVOLTS—DEFEAT AND DEATH OF VELA—GONZALO PIZARRO SEIZES TIERRA FIRME—BACHICAO SACKS PANAMA—HINOJOSA TAKES PANAMA AND NOMBRE DE DIOS—VERDUGO RETAKES NOMBRE DE DIOS—HE IS DRIVEN OUT—ARRIVAL OF GASCA—HE GAINS OVER MEJIA AND HINOJOSA—GOES TO PERU—DEFEATS AND KILLS GONZALO PIZARRO—REVOLT IN NICARAGUA—ASSASSINATION OF BISHOP VALDIVIESO—HERNANDO CONTRERAS PROCLAIMED "CAPTAIN-GENERAL OF LIBERTY"—GASCA RETURNS TO PANAMA—CONVOYS HIS TREASURE TO NOMBRE DE DIOS—THE REVOLUTIONISTS TAKE PANAMA—COUNTER-REVOLUTION—DEFEAT OF BERMEJO AND SALGUERO—DEATH OF HERNANDO CONTRERAS—END OF THE REBELLION.

PEDRO DE LOS RIOS held the governorship of Castilla del Oro until 1529, when he was compulsorily retired, fined, and forbidden to return to the Indies. His successor was Antonio de la Gama, who held office until 1534, when his place was taken by Captain Francisco de Barrionuevo. To Barrionuevo succeeded Pedro Vazquez, and to Vazquez, Doctor Robles. During all these changes Panama continued to grow as a place of importance. Until 1533 the law-courts of Castilla del Oro were subsidiary to the Royal Audience of Hispaniola, but in that year an Audiencia Real, or Royal Audience, was established at Panama, with jurisdiction not only locally but over the whole province and even for a time over Peru. Ecclesiastically Panama also flourished. Tomás de Berlanga, who was bishop from 1530 to nearly 1540, laid out the site for a cathedral, the convent of La Merced, and other religious houses. The church of Panama held ecclesiastical jurisdiction over the province of Nicaragua until 1531, in which year Diego Alvarez Osorio, precentor of Panama Cathedral, was consecrated first bishop of Nicaragua. Soon, too, the isthmus acquired a new importance as the highway for the treasure from Peru on its way to Spain.

Hitherto Castilla del Oro was brought into relations of a more or less hostile character with the countries to the north and west. It was now to come into conflict with the territory to the south and east. In 1532 Pedro de Heredia, having obtained a grant of the land lying between the Atrato and the Magdalena rivers, established the city of Cartagena, which in time became the capital of the Spanish Main and was destined to play an important part in the history of the Spanish occupation of America. A successful attempt on the part of Heredia's brother, Alonso, to rebuild on a somewhat different site the abandoned colony of San Sebastian led to a conflict between the two governments, and ultimately to the

delimitation of the eastern boundary of Castilla del Oro. By agreement made at Cartagena between Barrionuevo and Heredia, the Atrato River was fixed as the line of demarcation between the two provinces.

The northern portion of Veragua was still uncolonized. As early as 1514 King Ferdinand had offered Veragua to Bartolomé Colon for settlement, but, on account of the poor state of his health, the Adelantado declined the offer. On the death of Christopher Columbus's son and heir, Diego Colon, in 1526, Diego's son Luis, then six years of age, succeeded, as was thought, to the grants, titles, and dignities of his father and grandfather; but these being denied him, he went to law, in 1538, with the crown for the restoration of his prerogatives and privileges. The lawsuit was protracted, and finally, in 1540, a compromise was effected, by which Luis Colon surrendered his claim to the viceroyalty, and received in lieu thereof the titles of Duke of Veragua, Marquis of Jamaica, and Perpetual Admiral of the Indies.

Somewhat earlier and during Luis's minority, Diego Colon's widow, Doña Maria de Toledo, who is often spoken of as vireina or vice-queen of the Indies, having asked from, and been refused by, the Royal Audiencia of Hispaniola permission to colonize Veragua, determined to carry out her project without license from the king's representatives, trusting to the event to justify her action. Aided by an ecclesiastic named Juan de Sosa, she fitted out a force of 400 men, which she placed under the command of Felipe Gutierrez, with Pedro de Encinasola as his chief captain. Sailing from Santo Domingo in September, 1535, they landed in Veragua, and founded the town of Concepcion. But the constant rains, the debilitating climate, and the scarcity of provisions made awful havoc among the colonists, and two hundred of them soon died. Conditions were appalling. The corpses lay around unburied tainting the air. The survivors with great difficulty dug their own graves, in which they lay down when they found their end approaching. Forty men, reduced to desperation, set out for Nombre de Dios, but many of them died on the way. A small force of fourteen, sent out by Gutierrez to bring in recruits and supplies, fell in with the remnant of the forty, and, finding that they could not continue their route on account of the hostile attitude of the natives, the combined party fortified themselves in a camp with scarcely a hope that they would ever be relieved. Gutierrez at length abandoned Concepcion, and, with the few colonists that still remained, sailed for Nombre de Dios. Arrived there, he got some inkling of the plight of the two parties that had left Concepcion before he did, and a vessel well supplied with food and arms was sent in quest of them. They were at last found, and the survivors, to the number of twenty-seven, were brought back to Nombre de Dios. That was the end of Gutierrez's attempt to colonize Veragua. Seeking wealth and fame elsewhere, he went to Panama and from Panama to Peru, where he rose to be a governor, but was ultimately executed by Gonzalo Pizarro.

In January, 1537, Veragua was officially declared to be a dukedom of preëminent domain, and its dimensions were settled at 625 square leagues of land, extending 25 leagues westwardly to Bahia Corabora and 25 leagues in the direction of the South Sea. This was the duchy given to Luis Colon in 1540. In December, 1556, Luis, in consideration of a yearly grant of 7,000 ducats, gave up his claim to Veragua, which then became crown land. Thenceforward its settlement advanced with fair rapidity, until, by 1575, there were several townships dotted here and there over its surface, the gold mines being the general center of attraction.

Pedrarias was succeeded in the governorship of Nicaragua by Francisco de Castañeda, and he by Pedrarias's son-in-law, Rodrigo de Contreras, who had married Doña Maria, the lady who was at one time

betrothed to Balboa. Contreras was anxious to open up communication with the Caribbean coast by way of the San Juan River, but Bartolomé de las Casas, the Protector of the Indies, who was at that time in Leon, opposed and prevented the scheme, on the ground that its execution would lead to the enslavement and ultimate extermination of the natives. When Las Casas left Leon, however, the governor proceeded to carry out his original plan, and for that purpose, in 1539, sent forth Captains Diego Machuca and Alonso Calero with two vessels on the river and two hundred men who marched along the bank. They reached the Caribbean in safety and then sailed for Nombre de Dios. There Doctor Robles, the then governor of Castilla del Oro, arrested them, and sent out an expedition of his own under Francisco Gonzalez de Badajoz to take possession of the lower portion of the San Juan and the territory adjoining. For a time these invaders were successful, especially in the matter of collecting gold, but in about six months Contreras drove them out, and a like fate befell a second party sent by Robles under Andrés Garavito, so that the attempted encroachments on Nicaraguan territory by the governors of Castilla del Oro were unsuccessful.

Lying between the two provinces there was still, however, some unexplored and debatable land, corresponding in great part to the modern Costa Rica. To this section the name Nueva Cartago was given, and of Nueva Cartago Diego Gutierrez, a brother of Felipe's, was appointed governor in 1540. When Diego went to take possession of his province, he experienced particularly bad luck in the way of illness and desertions, but nevertheless he managed to sail in a small barque with a few followers from Nombre de Dios to the mouth of the San Juan River, whence he made his way to Granada in Nicaragua. There Contreras told him that Nicaragua extended to the confines of Veragua, and that there was no territory in between for further occupation. Gutierrez was, however, insistent on his rights, and after protracted negotiations he was allowed to sail with sixty men and two vessels for the mouth of the River Surre. Here he was deserted by all his men except six, but relief was obtained on the arrival of Captain Bariento, who brought, in a brigantine, a few men and some very much needed provisions. Gutierrez thereupon sent his nephew, Alonso de Pisa, to Nombre de Dios for more recruits and more provisions, giving him all the gold he had collected to enable him to procure them. De Pisa arrived at Nombre de Dios early in 1545, and having secured twenty-seven men and some supplies, he returned to Costa Rica, but met with such terrible weather that he was actually seventy-two days overdue. He at length reached his uncle's camp, and the latter sent the ship back for still more colonists, and, when they had arrived, set out with a force of about eighty men to explore his province. When he had reached the western section, he was set upon by the Indians, and he and all his party save six were killed. The six survivors were rescued by Alonso de Pisa, who appeared on the scene with a small force, and all made their way to the San Juan River and thence to Nombre de Dios. Thus ended the first attempt to colonize Costa Rica.

For some years a remarkable man, in the person of Bartolomé de las Casas, had been taking an active interest in the troubled affairs of the Spanish dominions of the west. Born at Seville in 1474, he, with his father, had accompanied Columbus on his third voyage in 1498, returning to Spain in 1500. In 1502 he went with Governor Ovando to Hispaniola, and there, in 1510, he was admitted to the priesthood, being the first man so ordained in the colonies. From Hispaniola he went, in 1511, to Cuba, where he in vain endeavored to prevent the massacre of Indians at Caonas in 1513 or 1514. A large village near Xagua being assigned to him and a friend named Rentería, with a "repartimiento," or allotment of Indians, he at first made the most of his opportunity to grow rich, but, convinced, after some

time, of the injustice and other evils of the repartimiento system, he began to preach against it, gave up his own slaves, and went to Spain to plead the cause of the oppressed natives. He succeeded so well that in 1516 Cardinal Ximenez sent out a commission of three Hieronymites to reform abuses, Las Casas himself being assigned to them as adviser, with the title of "Protector of the Indies." Not much progress, however, was made, and in the following year he returned to Spain, where, in order to liberate the Indians, he advocated an emigration scheme which would give every colonist the right to hold twelve negro slaves. This scheme proved a failure, and Las Casas, thoroughly disappointed and disgusted, returned to Hispaniola, where he joined the Dominican Order in 1522, devoting the next eight years of his life to extreme seclusion and to classical and scholastic studies. He then visited Mexico, Nicaragua, and Guatemala, and in 1537 was instrumental in peaceably converting to Christianity the inhabitants of Tuzulutan or Tierra de Guerra. In 1539 he was again in Europe, where he stayed for over four years. He paid several visits to Charles V in Germany, and, in 1542, handed to the emperor the manuscript of his famous disquisition on *The Destruction of the Indies* (*Breuissima Relacion de la Destruccion de las Indias*). Stimulated by this frank and convincing document, Charles appointed a royal commission of theologians and jurists to devise a better system for the government of his western possessions. This body drew up a code of regulations, which was promulgated at Madrid in 1543 and became known as the *New Laws*. Under this régime no more Indians could be enslaved, good title should be shown to slaves already held, and even of those the number that could be kept in captivity was strictly limited. The new code also abolished the audiencia of Panama, and established two new tribunals, one at Lima, for South America, and the other—the audiencia de los Confines—at Comayagua, with jurisdiction over Chiapas, Yucatan, Guatemala, Honduras, Nicaragua, and Tierra Firme or Castilla del Oro.

As might be expected, the new laws caused a furore all the way from Peru to Mexico. Men had grown so much into the habit of enslaving Indians and making a profit out of them that they deemed the recent legislation an unjust invasion of their rights and privileges, and they were prepared to go to extreme lengths in resistance. At this juncture, and when, after the series of struggles and executions which had steeped the soil of Peru in Spanish as well as in native blood, Vaca de Castro, the governor, was in command and on the verge of establishing stable government, Charles V sent out Vasco Nuñez Vela as viceroy, with instructions to carry out all needful reforms. When Vela, attended by the judges of a new Audiencia and an imposing retinue, arrived at Nombre de Dios in January, 1544, he at once proceeded to put his powers into force by seizing as a product of slave labor a quantity of gold and other goods, which the owners had acquired in Peru and which they were then about to ship for Spain. At Panama he acted similarly by ordering the release and return of several hundred slaves captured in Peru. He thus made it plain that he had come to administer the laws and not to compromise on them. When he reached Lima he imprisoned Vaca de Castro, and acted generally in a high-handed manner, which roused the gorge of everybody. When his proceedings became so impolitic as to be intolerable, Vela was actually deposed by the Audiencia he had brought out. He was ultimately defeated and slain by Gonzalo Pizarro at the battle of Añaquito, January 18, 1546.

In 1544, Gonzalo Pizarro, who was in revolt against the viceroy, was the dominant spirit in Peru, and, thinking to strengthen his position there, he evolved a scheme for becoming master of Tierra Firme by seizing Panama and Nombre de Dios, and thus controlling the direct line

of travel to Peru. To accomplish this purpose, he dispatched a considerable fleet and force under Hernando Bachicao to seize Panama. The people of Panama, however, being forewarned by Vaca de Castro, who had contrived to escape from Peru, determined to resist, and raised a force of 700 men to repel the invaders. A message reached Bachicao at the Pearl Islands that he was not to land his troops in Tierra Firme, to which the captain gave the evasive reply that his sole intention was to put passengers ashore and revictual his fleet. On this pretext he was allowed to enter the city, and immediately, and with scarcely any resistance, he seized all the arms and ammunition that were stored in the arsenal. The city itself he gave over to loot, and those of its citizens who were in any way obnoxious he put to death. Thus was inaugurated that series of pillagings and proscriptions of which Panama was destined to be so often the victim. But Bachicao had overshot the mark, and his violence led to his recall as soon as Pizarro learned of his performances.

Pizarro was, however, not a whit the less determined on securing possession of the two towns and the territory they commanded. A second expedition was equipped and sent out under the command of Pedro de Hinojosa. In October, 1545, Hinojosa dropped anchor in front of Panama with eleven ships. Once more the citizens determined on resistance; but just as a battle was imminent, the priests, clad in garments of mourning, came between the two little armies and implored of them not to shed each other's blood. An armistice of a day was thereupon arranged. Hinojosa took advantage of this breathing space to make representations that he had come not to wage war but to make restitution; that Pizarro was master in Peru, and meant to command the gateway to it; and that only in the event of the people of Panama not submitting would there be war. This announcement gave the Panamans food for thought, and an agreement was ultimately drawn up by which Hinojosa with thirty men was to be free to enter Panama and to stay for forty-five days, on condition that he send away the remainder of his forces and his ships to Taboga, or the Pearl Islands. Hinojosa was well versed in the arts of gaining over men's minds, and he made such good use of his time that, before the forty-five days had passed, he had got nearly everybody on his side, including even two agents of Vela, and amid all sorts of demonstrations of enthusiasm he was allowed to enter Panama formally at the head of his forces. He acted with great discretion, kept his troops in strict control, and still further enhanced his high reputation among the citizens by throwing the aegis of his protection over the peaceable conduct of their commercial pursuits. From Panama Hinojosa sent his son-in-law, Hernando Mejía de Guzman, and Pedro de Cabrera to take Nombre de Dios, and, this being done without trouble, Pizarro was in control of the highway to Peru.

But this state of affairs was not destined to continue long. One Melchior Verdugo, who was on the side of Vela, seized one of Bachicao's ships, and, sailing to Nicaragua, went down the San Juan River to the Caribbean Sea, and, thence proceeding to Nombre de Dios, landed in the night, entered the town, and surrounded with his followers the house in which Mejía and Cabrera lay. The two leaders, thus entrapped, made a gallant fight, succeeded in cutting their way through the hostile forces, and hastened to Panama, leaving Verdugo in possession of the northern settlement. Verdugo by a series of oppressive acts made himself very unpopular, and Hinojosa, on the invitation of the mayor of Nombre de Dios, appeared on the scene, and after a short skirmish drove the intruders to their ships.

In the meantime, the report of the rebellious proceedings in Peru was causing considerable annoyance and even grave anxiety at the court of Spain. A revolt was too serious a matter to be neglected, and it must be promptly put down. To

bring about a satisfactory settlement, it was decided to send out a new president of the Royal Audience, with extraordinary powers. The man selected for this delicate and difficult mission was Pedro de la Gasca, a clergyman and a counsellor of the Inquisition. With a small following, which included the Mariscal Alonso de Alvarado and the Adelantado Pascual de Andagoya, Gasca started from San Lúcar on May 26, 1546. At Santa Marta, where he put in, he was dumfounded by the news of Pizarro's victory at Añaquito and of the death of the viceroy Vela on that fatal field. When he reached Nombre de Dios he found Mejía in possession and holding the town for Pizarro. Gasca thus found himself in an extremely awkward predicament; but, being an able man, he rose to the occasion. He announced that his purposes were peaceful and that he had royal authority not only to condone offences but also to revoke the more objectionable features of the New Laws. This was to do away at one stroke with all reasons for a continuation of the rebellion; and accordingly Mejía went over to the side of the new president. Hinojosa, in Panama, was more difficult to handle; but eventually he, too, succumbed to the address of Gasca, to whom he handed over his fleet. Strengthened here and in other quarters, Gasca with more than 1,000 men arrived at Tumbez on June 13, 1547, defeated and killed Pizarro at the battle of Xaquixaguana, April 8, 1548, and thus put an end to what at one time threatened to be a formidable revolt.

Another rebellion was engineered a few years later in Nicaragua. Rodrigo de Contreras had been deprived not only of his governorship but also of his property in Nicaragua, mainly on the representations of Bishop Valdivieso of Leon, and when he went to Spain (1548) to seek justice, his appeal was rejected, and he was forbidden to return to the province over which he had once ruled. A scheme formed by his two sons, Hernando and Pedro, for the recovery of their father's property by force, was given a more ambitious turn by some malcontents who had been banished from Peru by Gasca for attempting an insurrection there after the defeat and death of Gonzalo Pizarro. The principal advisers of the two young men were Juan Bermejo and Rodrigo Salguero. The plan, simple in conception and bold in spirit, though likely to prove difficult in execution, was to seize first Castilla del Oro and then Peru, and, this accomplished, to proclaim Hernando king of the subjected territory.

To carry out a scheme so magnificent a beginning was made in Granada, where the popularity of the brothers Contreras speedily secured them a number of followers. The scene of operations was then shifted to Leon, where, at an entertainment given by Hernando, the decisions of the Audiencia depriving the colonists of lands and encomiendas were denounced, and a claim on Peru was put forward by Hernando based on some imaginary rights descended to him from his grandfather Pedrarias. It was not difficult to persuade men suffering from a sense of wrong to undertake a course of action which, if successful, would give them both revenge and wealth.

The first act of the conspirators in this weird but sternly tragic drama was to poniard Bishop Valdivieso to death in his own house and in the presence of his mother; the next to rush to the public square and proclaim Hernando captain-general of liberty; and the third to sack the treasury building and divide its contents among themselves. They then dispersed to various points to seek new recruits and take steps to prevent any premature announcement of their proceedings or plans. To Bermejo was assigned the task of returning to Granada in order to destroy the ships on Lake Nicaragua, so that no word of the outbreak could be conveyed to Nombre de Dios. He had only about thirty men, and when he came near Granada he was met by an opposing force of superior numbers under Captain Luis

Carrillo. An engagement took place, the result of which was decided by the desertion of several of the loyalists to the revolutionary standard. Carrillo himself was killed, as well as many of his troops, and Bermejo then entered the city, destroyed the ships, and took young Pedro de Contreras with him to join the other insurgents on the west coast.

Here they learned that Gasca was about to return to Spain with a large quantity of silver and gold. Their plans were straightway formed to get possession of this treasure, to kill Gasca and the governor of Castilla del Oro, to burn Nombre de Dios, Panama, and Natá, to lay waste Tierra Firme so that any army sent against them from Spain should find no means of subsistence, and then with a force of about 600 men levied on the Isthmus to sail for Peru and there set up Hernando as king.

It was a magnificent conception; but it required a master genius to carry it out, and there was none such among the rebels, while opposed to them was a man of real ability. Gasca had arrived at Panama on March 12, 1550, with silver and gold to the value of 11,000,000 castellanos. The responsibility for so much treasure made him anxious and suspicious, and, although the fleet had not yet arrived at Nombre de Dios, he thought it part of prudence to get his bullion away from Panama as quickly as possible. Accordingly, he sent 1,200 mule loads of gold and silver to Cruces on the Chagre to be shipped thence to the North Sea, where it could, he thought, more securely await the coming of the fleet. He and the governor went along to see that the trans-Isthmian transportation was safely effected. Two of the intended victims were thus out of the way when on April 20, 1550, Hernando and Bermejo and their followers appeared at Panama. They entered the city without opposition, shouting "Death to the Traitor!" and "Long live Prince Contreras, captain general of liberty!" seized the royal treasury, and secured all available arms and ammunition. The bishop and the officials had their lives spared on taking an oath to join the cause of the revolution. In the meantime, Pedro secured the ships lying at anchor in the harbor, and Salguero hurried off with a small detachment of mounted gunmen to overtake Gasca and capture the treasure. Hernando, leaving Bermejo to hold Panama, also went after Gasca in more leisurely fashion.

Then Bermejo did an extremely foolish thing. Believing that Hernando's force was not strong enough to cope with Gasca, he left Panama to the care of Pedro and the ships, and set out to join his leader. No sooner had he gone than a counter revolution was started, and excited crowds gathered, shouting, "Long live the King!" and "Death to Tyrants!" Pedro and his ships were attacked, and he had much ado to keep the enraged populace at bay. Arrived at Chagre, Bermejo heard of the altered situation at Panama, and, dispatching couriers in hot haste to Salguero and Hernando, he turned on his tracks and made a forced march back to Panama, covering the fourteen leagues in one day. He had been previously insistent on putting the bishop and officials to death, instead of sparing their lives and binding them by oath to the revolution, and he was now inflamed with a double thirst for their blood. Although his men were quite used up from their long and toilsome march, he insisted on attacking the city on the very night of his arrival. But, to his cost, he found that conditions had indeed changed. The streets were barricaded, and from the house-tops the citizens poured so well directed a series of volleys that the invading army was beaten off. Vowing vengeance and promising to set the town on fire the next night and to slaughter everyone over twelve years of age, he retired for the time being. His threats, reported in Panama, nerved the inhabitants to a supreme effort in self-defense. Instead of waiting to be attacked, they next day placed the women and children in the cathedral, and, sallying forth, carried the fight to the enemy. Astounded at this move, Bermejo fell back to a hill in the vicinity, where he

was joined by Salguero, who had found some treasure at Cruces and then hastened back to the support of his fellow-conspirator. In front of Panama there took place a desperate encounter, the result of which was the complete defeat of the rebels. More than ninety fell dead on the field, including Bermejo and Salguero. The rest were taken prisoners, and, without benefit of clergy, were stabbed to death in the jail to a man. Pedro de Contreras then made off with two ships, abandoning his other vessels. Pursuit was given, and Pedro and his men were driven to land at Punta de Higuera, where those who were not captured died of starvation or were killed by the natives. Another party of rebels under Landa, a lieutenant of Contreras, was also taken. The prisoners were all put to death, except twelve, and these met with a still worse fate in being sent to work in the galleys in Spain.

Hernando himself, who was waiting at Capira for Gasca to arrive with the bulk of the treasure at Nombre de Dios by the sea route from the Chagres River, had hastened to the assistance of Bermejo and Salguero; but having learned at Chagre the result of the battle of Panama, he disbanded his force, and bade every man make his way as best he could to the coast of the South Sea in the hope of being picked up by Pedro. The leader and a few of his friends did reach the Pacific, and put out to sea in a canoe, but a violent storm forced them back to the shore, where they were dispersed. In fording a river Hernando, weakened by hunger and fatigue, was drowned. His body, when found, was identified by an ornament which he wore around his neck, and the head which it was intended should wear a crown was cut off and exposed to the public gaze in an iron cage on the Plaza at Panama. His attempt was probably a mad one; it certainly was not based on justice or right; but the exercise of a little more judgment might have made it, if not a success, at least a formidable menace to the power of the Spanish monarchy in America.

CHAPTER VII

RAIDS BY THE ENGLISH

Discovery of Brazil—Brazil Falls to Portugal—Sebastian Cabot and His Father Discover North America—Jacques Cartier Discovers Canada—Huguenot Colonies in North America—English Merchants Trade Surreptitiously with the West Indies—Sir John Hawkins Defeated at San Juan de Ulloa—Sir Francis Drake—Early Voyages—Takes Nombre de Dios, but Fails to Secure Treasure—Captures Spanish Vessels—Sights the Pacific Ocean—Sees Old Panama—Fails to Capture the Treasure Train—Fails to Take the Plate-Ship at Veragua—Captures the Treasure Train on the Camino Real—Returns to England—John Oxenham Crosses the Isthmus—Sails into the Pacific Ocean—Takes Two Plate-Ships—Is Pursued, Defeated, Captured and Executed—Drake Circumnavigates the World—Is Knighted and Made an Admiral—Takes and Sacks Santo Domingo and Cartagena—His Exploits in Europe—Fails to Take the Treasure-Galleon at Puerto Rico—Sacks and Burns Various Towns—Again Takes Nombre de Dios—Fails to Take Old Panama—His Death and Burial—His Character.

IN accordance with the economic ideas then prevalent, Spain was naturally anxious to reserve to herself the exploitation of her new territories; but it was not long until this policy was thwarted, for other nations were determined to have a share in whatever spoils were going. Portugal claimed Brazil in virtue of its discovery by Pedro Álvarez de Cabral in March, 1500, although it had been already discovered in January of the same year by Vicente Yañez Pinzon for Spain. The distribution of previously unknown lands made by Pope Alexander VI in two bulls of May 2 and May 3, 1493, and the shifting of the papal line of demarcation effected by the Treaty of Tordesillas in 1494, made good the claim, and Brazil became and remained Portuguese.

Nor was England likely to be an idle onlooker, or scrupulously to respect an imaginary geographical line, by whomsoever drawn, if it stood in the way of her interests. Sebastian Cabot, English-born though of Italian parentage, was filled by the discoveries of Columbus with the desire of performing similar maritime exploits, and he and his father, John Cabot, so successfully mooted to King Henry VII the idea of shortening the route to India, by sailing westward on a more northerly track than Columbus had followed, that that astute sovereign authorized them by patent of 1496 to seek out, subdue, and occupy, at their own expense, any land before "unknown to all Christians." Accordingly, on May 2, 1497, the Cabots set sail from Bristol, and returned on August 6, having in the meantime discovered in June the *Terra primum visa*, or "land first seen," which is generally supposed to have been part of the mainland of North America, possibly Labrador. If this supposition is correct, the Cabots sighted the continent before Columbus or Amerigo Vespucci. In 1498 Sebastian Cabot again sailed into the west from Bristol port, and explored some 1,800 miles of the coast-line of the newly discovered country. Further commissions were issued by Henry VII in 1501, but nothing resulted, and then, strange to say, for a period of sixty or seventy years nothing was officially done in England to dispute with Spain the possession of any part of America.

In the meantime, however, the French had been busy. There is some record of a

French expedition to Brazil as early as 1503, and the Bretons under John Denys are said to have explored the Gulf of St. Lawrence in 1506. In 1524 Giovanni Verrazano, a Florentine, undertook the first official expedition to America on behalf of the court of France. He sailed from Dieppe in January with four ships, but he had only one, the *Dauphine*, when he reached the North American shore. He followed the coast from Cape Romain in South Carolina, or thereabouts, as far as Newfoundland, and frequently landed. He returned to Dieppe in the following July. In 1534 and 1535 Jacques Cartier discovered Canada, explored the estuary of the St. Lawrence, and gave its name to Montreal. In 1562 a Huguenot colony, financed and protected by Admiral Coligny, made an unsuccessful attempt to settle on the coast of South Carolina. A second Huguenot colony settled in 1564 in Florida, but was totally wiped out by the Spaniards under Pedro Menendez. A bloody revenge was taken for the cruelties of Menendez by Captain de Gourgues in 1567, but he accomplished nothing more, and, not daring to attack the fort of St. Augustine, which had been erected in 1565, he sailed away, leaving Spain still supreme in America.

But if the English government was supine, that was not the case with the English mariner merchants. With that instinct for commerce which has always been their characteristic, and that spirit of adventure which they so conspicuously showed during the sixteenth century, they soon began to do a surreptitious trade with the West Indies. Already in 1499 Ojeda reported that he found Englishmen cruising on the Pearl Coast, and as early as 1518 there is record that an English vessel, with a cargo of wrought iron and vessels of pewter and tin, arrived at Santo Domingo and, being repulsed from there by order of the governor, proceeded to Porto Rico, where those on board were allowed to barter their cargo for provisions. A few years later, as has been discovered, a secret agent for English merchants was resident in the West Indies, a fact which would go to prove that a trade was being done. In 1565 Captain Parker arrived off the coast of Darien to trade with the natives, an action so deeply resented by the Spaniards that they sent an armed flotilla to drive him away. Parker, however, refused to budge, and in a battle that ensued he beat off his assailants and captured one of their ships.

Nor were men of other nationalties long behindhand. French pirates and Dutch Zee-roovers, as well as English slavers and smugglers, are known to have cruised about among the West Indies early in the sixteenth century. Corsairs from France actually burned the Spanish settlement of Havana in 1555, and slaughtered all the inhabitants. These various nomadic bands ultimately developed into the notorious Buccaneers of the seventeenth century.

Among the celebrated Englishmen of that period who helped to thwart the policy of Spain and to humble her arms at sea, the first, in point of time, whose name we meet is Sir John Hawkins. To him is generally assigned the credit—such as it is—of being the first English slave trader to enter the Caribbean Sea. A Plymouth man and a sailor by profession, he came to know that negroes from the Guinea coast were profitable commodities to sell in the West Indies, and he made three voyages thither with cargoes of living freight for that purpose in 1562, 1564, and 1567. On the last of these expeditions he was accompanied by his kinsman, Francis Drake, who had already been to the Spanish Main on a similar mission with Captain John Lovell in 1565. Hawkins's squadron, which consisted of six vessels all told, sailed from Plymouth on October 2, 1567, and, having secured four or five hundred slaves on the African coast, proceeded to the Caribbean Sea and coasted along the northern shore of North America, the commander selling his slaves at each port of call. At Rio Hacha he was prevented from trading and, construing this prohibition as a violation of a treaty made between Charles V and Henry VIII and



PIRATES AND BUCCANEERS

1. Sir John Hawkins.
2. Sir Francis Drake.
3. François L'Olonois — From Esquemeling, 1684.
4. Bartholomew Portugues — From Esquemeling, 1684.

then still existing, Hawkins attacked and captured the town (1568), and was then allowed to sell some two hundred of his slaves secretly and at night. Debarred from Cartagena, the English seamen made their way through contrary winds to San Juan de Ulloa (Vera Cruz). There they were attacked by a fleet of thirteen armed Spanish vessels under Álvarez de Bazan, and so severely defeated that only two vessels, the *Minion* of 100 tons, on which was Hawkins, and the *Judith* of 50 tons, on which was Drake, succeeded in making their way back to England in January, 1569.

Hawkins appears to have sought no opportunity of revenge until it came ready to his hand, when, as Rear-Admiral on the *Victory*, he helped to defeat the Invincible Armada in 1588. Not so with Drake. In 1570 and 1571 he made two westerly voyages mainly for purposes of exploration. On both he not only traded with the inhabitants but also studied the coast of Darien, and found out all he could about the route taken by the treasure trains in crossing the isthmus from Panama to Nombre de Dios. In May, 1572, he once more sailed from Plymouth with two ships, the *Pasha* of 70 tons, and the *Swan* of 25 tons, with a company of 73 men and boys, included in whom were his brothers John and Charles Drake and John Oxenham. In July he dropped anchor in a hidden harbor in the Gulf of Darien, which he had discovered on an earlier voyage, and to which he had given the name of Port Pheasant. Here he was joined by Captain James Rause of the Isle of Wight, who along with his own English barque brought in two Spanish vessels he had recently captured. About two weeks later the whole party sailed for the Isle of Pines. Here Drake left Rause with a small party to guard the ships, and taking 73 men, in three pinnaces and a shallop, he set out himself to capture Nombre de Dios. This feat he accomplished after a sharp hand-to-hand fight on the morning of July 29, 1572, but, as the dislodged garrison was returning and succor was arriving from Panama, and as Drake was sorely wounded, the English freebooters had to beat a hasty retreat and so secured but little loot. The necessity for flight must have been very urgent, for they saw, and left behind them, silver in bars to the value of a million pounds sterling, and had actually reached the door of the King's Treasure House, where, as they well knew, were stored in large quantities pearls, jewels, and gold. They got safely away, however, in their pinnaces and in a Spanish merchant vessel which they took in the harbor, and went back to the Isle of Pines.

Rause then returned to England, and Drake sailed to the vicinity of Cartagena, where he made prize of some Spanish ships. While lying before Cartagena he seems to have developed the plan of capturing on land the treasure-train as it conveyed across the isthmus the silver and gold from Peru. It was then the middle of August and the rainy season was on, preventing overland transportation of bullion, so that a delay of some months was necessary before the venturesome scheme could be tried. In the meantime the great pirate privateer, whose very name, metamorphosed into El Draque, was already causing terror along the coast, put into a harbor in the Gulf of Darien, to which his men gave the name of Port Plenty because of the abundant stores they took with them and also because of the bounteous supplies of fish, deer, and wild hog which they there found.

The active spirit of the commander would not, however, allow him to be still. Leaving his brother in charge of the shore camp at Port Plenty, he sailed along the coast in two pinnaces, effected more than one landing, captured six vessels well stored with provisions, and, in sight of two armed frigates which declined to engage him, burned and sank two ships which had been sent out of Cartagena without cargoes. On his return to the camp in November, he found that his brother John had been killed in an attempt to board a Spanish frigate from the *Lion* pinnace without sufficient offensive equipment. He was to suffer still

further losses, for when the dry season came in January his men were attacked by a calenture, and twenty-eight of them, including his remaining brother, died.

Word soon came in from friendly Cimarrones that the galleons for conveying the plate to Spain had arrived at Nombre de Dios, and that the overland pack train might accordingly be expected to start from Panama without much delay. This was the opportunity for which Drake was waiting. Early in February, 1573, leaving all the sick and a few men in health as a guard for the camp and vessels, he started with only eighteen companions on his bold enterprise. He was joined on the way by thirty Cimarrones under their chief, Pedro. On the seventh day's march they came to a high tree on a mountain top, and, ascending it by means of steps cut in the trunk, Drake saw both the North and the South seas at the same time, being thus the first Englishman to set eyes on the Pacific Ocean. Three days later from a point of vantage he was looking down the main street of Old Panama at the plate fleet, which had arrived from Peru. Through a Cimarrone spy he learned that the mule train, bearing provisions, silver, gold, and jewels, was to start that night. Thereupon he fell back towards Cruces, and, dividing his men into two groups, stationed one on one side of the Camino Real and the other on the other side, with about fifty yards between them, so as to attack the mule train in front and rear at the same time and thus secure all the treasure. His scheme, which was so daring in its simplicity, miscarried through an accident. His men had put on their shirts over their armor so as the more easily to recognize one another in case of a fight, and one of them, Robert Pike by name, having imbibed too freely of brandy and being impelled by drunken curiosity, stood up when he heard a horseman coming from Cruces. This strange apparition in white so frightened the unknown rider, that he clapped spurs to his animal, and quickly got out of harm's way, and galloping towards Panama warned those in charge of the treasure of danger ahead. When the train did arrive at the place of ambush, it was captured without even the show of resistance; but there was neither silver, gold, nor jewels—nothing but provisions. The treasurer of Lima had met craft with craft. Dreading to remain any longer with so small a force, as he knew the next train to come along would be heavily guarded, Drake broke up his ambush and, utilizing the captured mules, made a dash on Cruces, which, after a smart skirmish, he captured and held for one night. Not finding any loot of value, he took his departure the next morning, and in about a week reached his camp and ships.

Drake next turned his attention towards the capture of a frigate which he learned was soon to leave Veragua with a million of gold on board. Taking only one ship, the *Minion*, he was guided thither by a Genoese pilot of a vessel which he had recently taken; but as soon as they reached the entrance of the harbor by night, two signal guns were fired and were answered by two other guns from the direction of the town, which lay five leagues up the harbor. Judging that the whole coast line was on the alert, Drake, baffled once more, drew off and returned to his camp, where he had the minor satisfaction of finding John Oxenham in possession of a captured frigate, which contained plenty of corn and some hogs and poultry. Here he was joined by about seventy French corsairs, whom he gladly welcomed, as they greatly strengthened his force for his next undertaking.

The Cimarrone spies had brought in the pleasing intelligence that three pack trains of bullion, with 190 mules each carrying three hundred pounds, was to arrive at Nombre de Dios on the 1st of April. Sailing on March 30 from his rendezvous point with fifteen Englishmen, twenty Frenchmen, and a number of Cimarrones, Drake landed not far from that town. He then cut in through the jungle until he struck the Camino Real about a mile on the Panama side of Nombre de Dios. The next night, March 31, he stationed his men in

concealment along the road until the mule team came in sight. They then fired a volley of gunshot and arrows, which brought the mules to a stop, and after a short but vigorous defense the guards fled. The freebooters went leisurely through the spoils, and took all the treasure they could with safety carry. To their great regret they were obliged to leave behind about fifteen tons of bar silver. After some exciting adventures they at length reached their ships, and having made a fair division of the booty with the Frenchmen, the Englishmen sailed for home. They arrived in Plymouth, after an absence of nearly fifteen months, on Sunday, August 9, 1573. When the ships reached the wharf, divine service was going on, but nearly all the congregation flocked out of the church to see the daring navigator who had brought what his fellow townsmen considered his great adventure to so successful a termination.

For over four years Drake, being otherwise occupied, was unable to give any attention to the Spanish Main. But one of his companions, John Oxenham, thought he would emulate the deeds of his commander. In 1575 Oxenham set sail for the coast of Darien, having one ship of 120 tons and 70 men. From the Cimarrones, who were still friendly to the English, he learned that, taught by experience, the Spaniards now sent a strong guard of soldiers with the treasure-train on its overland route. Oxenham thereupon abandoned his first idea of robbing the train, and decided to cross the isthmus and seek his fortune in the South Sea. He ran his vessel ashore and buried most of his ordnance, and after a toilsome march from the Caribbean coast into the interior, he and his companions at length reached a river which flowed into the Pacific. Down this they floated on a large pinnace which they had hastily constructed, and so sailed through the Bay of San Miguel and out into the Gulf of Panama—the first Englishmen to cross the isthmus and enter the South Sea. In a few days they were fortunate enough to make prize of two barques, one from Quito with bread and wine and 60,000 pesos of gold, and the other from Lima containing 100,000 pesos of bar-silver. They then made for the Pearl Islands, but finding only a few pearls there, they hastened back to the bay of San Miguel, and proceeded to recross the isthmus with their spoils, using the riverway as far as they could. A discussion took place about the division of the gains, and Oxenham, beaching the pinnace, buried the treasure, and set out to find Cimarrones to help him to carry it to where his ship lay on the north coast.

The delay thus caused proved fatal. No sooner had the Englishmen left the Pearl Islands than a messenger was dispatched in all haste to apprise the governor of Panama of the facts. The governor acted with promptitude, and within two days sent out four vessels with 100 soldiers and numerous Indians, under the command of Juan de Ortega, with instructions to seek, find, and punish the marauders who had had the audacity to carry on their depredations in the South Sea, still regarded as the inviolable property of Spain. Ortega successfully tracked them to where the pinnace had been left, and then followed the land trail, came on the buried treasure, unearthed it, and proceeded to carry it back to Panama. Oxenham, having in the meantime heard of the pursuit, turned back to regain the coveted treasure. A fight took place which resulted very decisively in favor of the Spaniards, who beat off the attackers and not only held the treasure, but killed eleven of their assailants and took seven of them prisoners. On their arrival at Panama the prisoners were forced to tell all they knew, and especially about the location of Oxenham's ship on the Caribbean shore. Word was at once sent to Nombre de Dios, and when Oxenham and the survivors of his party reached the spot, they found their ship, cannon, and stores removed. They were thus caught in a perfect trap. They wandered about among the natives for awhile and endeavored to build canoes to escape in, but eventually were made prisoners by the

Spaniards. Brought to Panama and questioned as to whether he had a commission from the English queen or any other ruler, Oxenham replied that he was acting entirely on his own account and fighting for his own hand. He and his men were thereupon condemned to death, and most of them were executed at Panama. Oxenham himself, with his officers and some boys, was sent to Lima to be interrogated by the viceroy, and there all, save the boys, were put to death. Thus the first English crossing of the isthmus and entry into the Pacific Ocean had a most disastrous ending.

Drake never forgot the view he had obtained of the South Sea from the tree-top on the isthmus, nor a vow that he had made to explore that strange ocean one day in an English ship. As soon as he was free to undertake such an expedition, he got together a squadron of five ships, and with them started from Plymouth on December 13, 1577, on what was ultimately to prove to be his celebrated voyage of circumnavigation of the globe. His exploits on the *Golden Hind* in the Pacific Ocean, and his performances ashore whenever he touched land, read like tales of romance, instead of a narrative of sober facts; but they do not belong to this history. Suffice it to say that El Draque terrorized the whole western coast line of Spanish America, captured ships at Valparaiso and Callao, robbed a llama-train, boarded the treasure galleon nicknamed the Cacafuego and plundered her of 26 tons of silver, 80 pounds of gold, 13 chests of money, and numerous jewels, took possession of the country now known as California for the English queen and called it New Albion, sailed for home by way of the Philippines, the Moluccas, the Celebes, Java, the Cape of Good Hope, and Sierra Leone, and finally dropped anchor in Plymouth Harbor on Monday, September 26, 1580, having been absent three years all but three months, and being the first Englishman, and the second of any country, to circumnavigate the globe. In recognition of this remarkable performance, he was knighted in April, 1581, by Queen Elizabeth at Deptford on the deck of his own ship, the *Golden Hind*.

In 1585 Drake was commissioned as an admiral and set out with a fleet to attack Spain once more in her western colonies. He captured and sacked Santo Domingo in Hispaniola (1586) and held it to ransom for 25,000 ducats, and then served Cartagena in similar style, the ransom here being 30,000 ducats. He then intended to take Nombre de Dios a second time, and thence cross the isthmus to Panama to strike another stroke for the treasure, but was deterred by the great mortality among his men from calenture. Instead, he sailed for Cuba; thence to Florida, where he captured the fort of San Juan de Pinos and burned St. Augustine; thence to Roanoke, where he took on board the 103 survivors of Sir Walter Raleigh's colony; and thence for Plymouth, where he arrived on July 28, 1586, bringing with him as spoils specie to the value of 60,000 pounds sterling and 240 pieces of ordnance.

Between April and June of the following year (1587), with a fleet of 21 ships, Drake sailed into the harbor of Cadiz, drove the armed galleys under the guns of the castle, looted and destroyed more than a hundred ships in the harbor and a hundred more which he subsequently met, and took and brought into Plymouth a Portuguese carrack, the *St. Philip*, heavily laden with treasures from the East. As vice-admiral Drake was second in command to the lord high admiral of England, Lord Howard of Effingham, in the series of engagements in which, aided materially by their allies the winds, the English defeated the Invincible Armada in 1588. Next year he was still busy fighting in Europe; and in the four following years he was performing duties incidental to civil life.

But the lure of the West was always upon him. Ashore or afloat, he had the consuming desire to make another dash at Nombre de Dios and thence to make a trans-isthmian march to sack Panama. To compass this end he had got together by August, 1595, a fleet of 26 vessels. But

Queen Elizabeth, having heard that a plate-ship with treasure to equip another Armada was in difficulties in Porto Rico, ordered the fleet to proceed thither in search of her. Near Porto Rico old Sir John Hawkins, who was vice-admiral on this expedition, died and was buried at sea. The Spaniards, having learned in the meantime that Drake was on the way, took off the treasure and carried it ashore and then sank the great galleon in the mouth of the harbor of San Juan. These were excellent tactics, and they foiled Drake. He succeeded indeed in making his way into the harbor, where he burned six ships; but he was unable to accomplish his chief purpose, and so he stood away for the Spanish Main. He sacked and burned La Hacha, Rancheria, Santa Marta, and other towns and villages. He then took Nombre de Dios, and sent out a force of 750 soldiers under Sir Thomas Baskerville to follow the Camino Real to Panama. The Spaniards, however, were well prepared. Obstructions were erected along the road at every point of vantage, and the little army was raked by gunshots from parties lying in ambush in the jungle. Thus hampered at every step, Baskerville got no more than half way to Panama when he thought it part of discretion to turn back. When he and his men arrived, footsore and half starved, Nombre de Dios was given over to the flames, and all the vessels in the harbor, as well as those which had been beached, were burned.

The English then steered for Porto Bello, and on the way Drake fell sick. From Porto Bello they proceeded to San Juan de Nicaragua, but were driven back by a storm. Drake became delirious and talked incoherently. Then he got up, put on his uniform, called clearly for his arms, lay down thus accoutred, and died within an hour. The ships continued their course to Porto Bello and there came to anchor. Next day, January 29, 1596, the admiral's body was placed in a coffin of lead, carried a league to sea, and there committed to the waves. Sir Thomas Baskerville then assumed the command and steered for England. Off the Isle of Pines near Cuba he fell in with twenty Spanish ships and after a sharp action repulsed them. The expedition, which had so unfortunate an ending in the loss of its great leader, reached England in safety the following May.

Drake was about fifty-six years of age at the time of his death. He appears to have been brown-haired, fair-complexioned, and under medium height, but broad-chested and strong-limbed. He stands boldly out as one of the historic figures of the spacious times of the great Elizabeth. His ethics, if judged by modern standards, would doubtless not pass muster; but they were the ethics of the time. Those who find that there is a glamour of romance about the raids and harryings of the Scottish border —and who does not?—or who are willing to overlook the seamy side of Dick Turpin's character for the sake of his daring if mythical ride to York, will assuredly find that the glory of Drake's career more than compensates for its questionable incidents of smuggling, and piracy, and highway robbery. Nor must we forget that he had some very commendable traits of character. He laid it down as an inflexible rule, both to his own men and to the Cimaroons who were his allies, that they must never harm a woman and never attack a man who was not carrying weapons against them. And something of old-time chivalry is found in his relations with the dignitaries of the cities he sacked, for we find him courteously treating them and even hospitably entertaining them whenever opportunity permitted. He was, besides, in his pirate days, scrupulously fair in his dealings with his fellow-thieves. Although his positive achievements in foreign parts are not to be compared to those of the Conquistadores, who carved out for Spain colonies of greater riches and extent than all the kingdoms and empires that Europe then knew, yet he rendered signal services to his country. He showed how weak Spain was in her distant colonies, and proved to onlooking Europe that by sea as well as by land England was growing

to be one of the great powers. Both by his daredevil exploits as a plain pirate and his more rational performances as an admiral of the fleet, he made Englishmen feared and respected. In each character he left a proud name which is enshrined in song and story and which his countrymen will never willingly let die.

CHAPTER VIII

PANAMA'S EARLY GROWTH AND DECLINE

GROWTH AND PROSPERITY OF PANAMA—ITS SIZE AND POPULATION—ITS DECLINE—THE CIMARRONES: THEIR RAVAGES—EXPEDITIONS AGAINST THEM—THE AUDIENCIA OF PANAMA ABOLISHED—RESTORED—THE AUDIENCIA DE LOS CONFINES—PANAMA SUBJECTED TO PERU—TRANSFERRED TO NEW GRANADA——RIVAL ROUTES THROUGH CENTRAL AMERICA—ABANDONMENT OF NOMBRE DE DIOS—SETTLEMENT FOUNDED AT PORTO BELLO—DISAPPEARANCE OF EARLY COLONIES.

THROUGH all vicissitudes Panama continued for many years not only to hold its own but to grow in population and wealth. Situated in the very center of the colonial possessions of Spain, its position as the terminus of the Camino Real and as the Pacific port of entry for gold, silver, pearls, and general merchandise from South, Central, and North America, from the neighboring islands, and from China, the Moluccas, and the Philippines, as well as the port of distribution for commodities brought from Europe, made it the great emporium between East and West, and gave it an importance such as no other American city for a long time possessed. Its warerooms were piled high with natural products and the products of industry from every quarter of the world; its merchants vied with those of any other country in wealth and display. A veritable golden age of prosperity had come to the former obscure village.

The size and population of the city of Panama, however, have been probably greatly exaggerated. In 1529, ten years after its foundation, it had 600 householders, and, despite an unhealthy climate, and the spread of infectious diseases, the number continued for many years to increase. But we are told that in 1610, its population was scarcely one-third of what it had been in 1585. At the later date Panama had, all told, eleven streets, three squares, and 484 houses, besides a cathedral, a hospital, seven religious institutions, and ten official buildings. A destructive fire which occurred in 1644 burned down 97 houses, and, following this event, Juan de Vega Bazan, the governor, wrote to King Philip IV.: "Panama has now but a small population, and this decreasing more and more every day." Yet Esquemelin, who accompanied Morgan's buccaneers when they sacked the city in 1671, says that it then contained "two thousand houses of magnificent and prodigious building," inhabited by vastly rich merchants, and five thousand houses more, occupied by persons of lesser quality and tradesmen. It is difficult to doubt or dispute the statements of an eyewitness; but the increase here indicated seems quite incredible, and all subsequent investigation would go to show that Old Panama never contained seven thousand houses and a corresponding population. If we set the number of inhabitants down at 10,000 in its palmiest days, it is likely that we shall not be far wrong.

The era of greatest prosperity of Panama was probably from about the middle to the end of the sixteenth century. Early in the seventeenth century it entered on a period of decline. The causes of the falling off were many. The mines of Tierra Firme, which reached their greatest output about 1570, were thenceforward but indifferently worked, the pearl fisheries were exhausted and lay idle, trade in the necessaries of life was in the hands of monopolists, who rigged the market to suit their own purposes and increase their gains. The imports of treasure from the three Americas began

also to diminish, for the yield was not maintained, and, besides, Cartagena had in some measure superseded the isthmian cities as a port of call and an entrepôt of commerce between the new world and the old, especially in the matter of pearls and of Central American products, which latter were conveyed thither by way of the Desaguadero River and the Caribbean Sea. In addition, the colonial policy of the mother-country was short-sighted in the extreme. The trade between Panama and China and the Philippines was highly lucrative, but because it led to a decrease of trade in the Castilian kingdom, it was absolutely forbidden by royal decrees of 1578, 1593, 1595, 1599, and 1609. Even the trade in native products was hampered by fiscal regulations which had regard more to the prosperity of Spain than to that of her colonies. Striking evidences of the falling-off of commerce are shown by two facts: first, that the revenues of the casa, or custom-house, of Cruces, which had been formerly rented out at 10,000 pesos a year, were let in 1610 for 2,000; and secondly, that the number of merchant vessels reaching the isthmus, which had fluctuated from 71 in 1585 to 69 in 1596 and reached its highest point of 94 in 1589, had by 1606 dwindled to 17.

A revival of the pearl industry and of gold-mining in the isthmus did indeed take place near the close of the seventeenth century, and the latter business was then so brisk that more gold was sent to Panama from Veragua and especially from Darien than from all the other mines in Spain's colonial possessions; but the depredations of corsairs and others had become so frequent and destructive that, from 1748 onward, intercourse between the home country and her American colonies was generally by way of Cape Horn, and the sending of fleets to the isthmus was abandoned. Before the end of the eighteenth century the mines were again exhausted, agriculture and manufactures were neglected, and the trade of Panama had gone down almost to the vanishing point.

Another cause of disturbance of business and its consequent decline in the sixteenth and seventeenth centuries was the condition brought about by the importation of negro slaves. This policy had been inaugurated in 1508 and had been recommended by Las Casas, although he afterwards repented of it, and as early as 1517 it had been authorized by royal order. In the years following large numbers of negroes were imported from the Portuguese settlements on the African coast, and a lucrative trade in those unfortunate human beings was done alike by those who received the necessary license and by those who were engaged illicitly in such enterprises. So important was this traffic considered that in the treaty of Utrecht which, in 1713, brought to an end England's share in the War of the Spanish Succession, a special assiento was included, which gave to Englishmen for 30 years the exclusive right to supply the Spanish colonies with negro slaves, as well as the privilege of sending every year to Porto Bello one vessel of 500 tons burden laden with European merchandise. This assiento was made over to the South Sea Company in 1720: it was finally abrogated in 1750, a compensation of £100,000 being paid by Spain to the company in consideration of its cancellation.

Now, from the earliest times, many of those negroes, driven thereto by bad treatment, escaped and took refuge in the jungle, the forests, and the mountain defiles, where, in ever-increasing numbers, they led a roving life, and frequently made common cause with the native Indians against their common oppressor. They continually attacked both the treasure train on its way from Panama to Nombre de Dios and passengers en route to or from either city. They despoiled mining-camps, set fire to houses, destroyed plantations, carried off women, stole merchandise, and slew settlers. In all their attacks they gave no quarter, for they expected none themselves. In process of time they became organized into regular companies, and, under the name of Cimarrones (by Englishmen frequently called Cimaroons), became a far-spread

source of terror to Spanish officials, merchants, and colonists.

By 1554 the menace to life and property had grown so great that the viceroy of Peru, Andrés Hurtado de Mendoza, Marques de Canete, then on his way to his province, commissioned Pedro de Ursua, founder of the city of Pamplona, to raise troops and proceed against the offending marauders. With about 200 men Ursua started from Nombre de Dios on his difficult mission. The Cimarrones, to the number of 600, were under a man of their own race, Bayona by name, whom they had elected king. For two years the guerilla warfare was drawn out, but at length Ursua succeeded in capturing Bayona, who was sent as a prisoner to Spain, and in forcing those of his followers who were still left to sue for peace. In 1570 the Cimarrones founded a town of their own, Santiago del Principe. In 1574, on submitting and guaranteeing to lead a peaceful life, they were by royal decree declared to be free men. The peace thus secured was of short duration, however, and depredations on the part of the Cimarrones became so frequent that the Spanish king determined to exterminate them. In 1578 Pedro de Ortega Valencia was sent against them at the head of a well-equipped force; but he did not fully succeed in his attempt. The Cimarrones, acting in conjunction with the buccaneers, opened a road in 1596 from Santiago del Principe to the River Chagre, with the object of more easily seizing treasure and merchandise on the Camino Real. Despite every expedition sent against them and every attempt to wipe them out, they remained for years a constant threat to Spanish interests, and the allies of every invader who wished to devastate the Spanish settlements or to humble the Spanish power.

The Audiencia Real, which, as we have seen, was established at Panama in 1533, was abolished in 1543, and Panama was made subject to the Audiencia de los Confines, which was located first at Comayagua, then at Gracias á Dios, and finally at Santiago de Guatemala. Later, however, Panama was given an audiencia of its own, for we find that early in 1560 a royal decree was issued, by which the government of Tierra Firme was vested in the president of the audiencia resident in Panama. This proceeding stimulated Guatemala to long-continued resistance, which finally succumbed only in face of subsequent imperative mandates. In 1564 the Audiencia de los Confines was removed to Panama, a fact which caused great demonstrations of enthusiasm throughout the isthmus. Its jurisdiction extended as far north as the Gulf of Fonseca on one ocean and the mouth of the River Ulua on the other, but did not include Gracias á Dios or San Gil de Buenavista, which, with their districts and the provinces of Guatemala, Chiapas, Soconusco, and Vera Paz, were handed over to the audiencia of New Spain or Mexico. This was an inequitable arrangement for Guatemala and the other provinces, and, after many petitions on the subject, the audiencia was in 1569 once more transferred to Santiago.

By royal decree of February 26, 1571, confirmed subsequently in 1614, 1620, and 1628, Tierra Firme was brought under the domination of the viceroy of Peru in all that appertained to government, war, and finance, but not in civil matters, which were left, as before, in the control of the audiencia of Panama. This condition of affairs lasted until 1718, in which year the three provinces of which the isthmus then consisted—Castilla del Oro, Veragua, and Darien—were transferred to New Granada, the seat of government of which was at Santa Fé de Bogotá. With New Granada, or part of it, Tierra Firme continued to be associated, with one or two short intervals, until it declared its independence in 1903, and set up government on its own account as the Republic of Panama. In 1794 an Audiencia Real y Chancelleria was established at Panama, having for its jurisdiction the provinces of Castilla del Oro and Veragua, and touching east, south, and west, respectively, on the territories subject to

the audiencia of New Granada, of Quito, and of Guatemala.

The route between Panama and Nombre de Dios was not allowed to retain its supremacy unchallenged. Although the distance between the two cities was only eighteen leagues, the cost of the journey was proportionately very high. Besides, the climate of Nombre de Dios was extremely unhealthy; it was liable to be flooded in the rainy season, and in the dry season it suffered from the want of fresh water; the harbor was bad and shipwrecks there were frequent; and town and harbor lay exposed as an easy prey to pirates. For these reasons many merchants were found to favor the removal of the Atlantic port of entry and disembarkation to one of the harbors on the Honduras coast, whence the overland journey to the Pacific, though nearly three times as long, could be performed at a more reasonable rate of charge. An inquiry into this matter, undertaken at the instance of the king by Juan Garcia de Hermosillo in 1554, resulted in a report, made in 1556, in which Trujillo in Honduras was advocated as the port of call, whence goods and passengers could be conveniently carried across country to Realejo on the Gulf of Fonseca, and there reshipped for transportation to Peru and elsewhere. Further investigation was carried on between 1556 and 1558, and a recommendation of the transfer proposed by Hermosillo was the result. Petitions in this sense were, naturally enough, adopted by the cabildo, or town-council, of Santiago in 1559, 1561, and 1562. A memorial from Felipe de Aniñon, who had lived long in the Indies, recommending the abandonment of Nombre de Dios and Panama, in favor of Puerto de Caballos and Fonseca, respectively, contained some cogent reasoning, and carried great weight with the Council of the Indies and the king.

At length, on the report of the royal surveyor, Jean Baptiste Antonelli, a change was effected, but by it Panama remained undisturbed, and the Atlantic port of entry was not removed from Tierra Firme, because another site was selected in that territory. "If it might please your majesty," wrote Antonelli, "it were good that the city of Nombre de Dios be brought and builded in this harbor." By "this harbor" was meant that of the village of Porto Bello, which was situated about five leagues west of Nombre de Dios. Porto Bello had the advantage of a commodious harbor with good anchorage, and could readily be fortified against attack from the sea. There, accordingly, in 1597 was founded a new settlement, which in time became one of the most important as well as one of the most famous cities on the Atlantic coast.

Belen, San Sebastian, Antigua, and Nombre de Dios, the earliest settlements, had thus either wholly or partly disappeared; another was Acla, which by 1580 was no longer existent.

CHAPTER IX

THE BUCCANEERS

Fortifications of Tierra Firme—Parker Takes Porto Bello—The Buccaneers —Fate of L'Olonnois—Mansvelt's Attack on Natá and Cartago—Morgan's Career—Sack of Porto Bello—Capture of Fort San Lorenzo —Morgan's Trans-Isthmian March—Capture of Panama—Destruction of Panama by Fire—Morgan Cheats His Comrades—He Escapes With the Spoils—His Subsequent Career—Foundation of New Panama —Its Fortifications—Porto Bello Again Taken by Pirates—The Emperor of Darien—King Golden-Cap—Capture of Santa Maria—Battle in Panama Bay—Panama Blockaded—Sawkins Attacks Pueblo Nuevo—His Death—Raids of Captain Sharp—Watling Attacks Arica—His Death—Sack of Esparza—Sharp Takes the San Pedro—Sharp's Return to England—His Trial and Acquittal—Dampier Recrosses the Isthmus —Surgeon Wafer's Experiences—Dampier Joins Another Buccaneer Party—The Buccaneers Outside Panama—They Fail to Take the Treasure Fleet—Dampier's Subsequent Career—Captain Townley's Depredations—Grogniet and Townley Attack Nicaragua—Townley Captures Villa de los Santos—Secures Immense Booty—The Buccaneers Ambuscaded—Death of Townley—Depredations in Veragua —Further Raids of the Buccaneers—Their Overland March to the Atlantic—Garcia Defeats Petitpied—Garcia Turns Traitor—His Exploits—His Death—Causes of the Collapse of the Buccaneers.

THE ravages of Drake and the invasions of other adventurers had proved conclusively that the coast guards established in 1529 by the governor of Santo Domingo, with instructions to seize every ship that did not fly the flag of Spain and to enslave its crew, were ridiculously inadequate to the grave emergencies which had since arisen. It was evidently necessary for Spain to adopt more vigorous measures to secure her distant colonies from outside attack. We accordingly find that in 1580 three men-of-war were stationed on the coast of the isthmus as a protection against pirates and raiders, and eleven years later a larger fleet still was sent for the same purpose to the West Indies. But this was not enough; land defenses were essential. Therefore Cruces and other points on Tierra Firme were fortified. In 1595 the fort of San Lorenzo was erected at the mouth of the Chagre. Standing on a high rock which made it inaccessible from the south, it was protected on its northern side by the river which there widened. Four bastions with big guns swept the landward approaches, and two others commanded the outlet of the river, which a sunken reef and sand bar made still more difficult of entry. The fortress was surrounded with palisades filled in with earth. A drawbridge, which spanned a yawning chasm in the rock thirty feet deep, was the sole method of approach to its one and only entrance. San Lorenzo was undoubtedly a strong citadel.

Still stronger were the defenses of Porto Bello. We have seen that one of the reasons for the removal of the settlement of Nombre de Dios to Porto Bello was the fact that the latter place could be much more easily rendered secure against attack from the sea. In the same year (1597) in which the removal took place artificers were sent out from Spain to erect without delay the necessary defensive works, and by them

Porto Bello was stoutly fortified. The fortress of San Felipe, with thirty-five great pieces of brass ordnance and a garrison of fifty soldiers, protected the entrance to the harbor; directly opposite it was a smaller fort named Santiago, with five pieces of ordnance and thirty soldiers; in Triana, an eastern suburb, there was another fortified castle; and similar forts commanded all the approaches by land and sea. In the city itself the King's Treasure House was solidly built, and was always guarded by a numerous and well armed force. All these defenses were soon to be put to a severe test.

In November, 1601, Captain William Parker, with 200 men and two ships, two shallops, and a pinnace, sailed from Plymouth, and, after an adventurous voyage, during which he had several successful piratical engagements, he arrived off the island of Bastimentos. Here he embarked 150 of his men in his vessels of light draught, and entered the river on which Porto Bello lies in the early morning hours of February 7, 1602. The moonlight showed the little flotilla plainly to the sentries on Fort San Felipe, and those watchers of the night immediately challenged to know whence the new arrivals came. The reply, given purposely in Spanish with intent to deceive, was that they had come from Cartagena. The ruse was successful, and the strangers were ordered to anchor, an order with which they at once complied. Later, when the excitement caused by his coming had somewhat subsided, Parker contrived to slip past both San Felipe and Santiago, and landing at the suburb of Triana, he immediately set that town on fire and made straight for Porto Bello itself. Here he found the governor, a brave man named Melendez, at the head of a squadron of troops ready to receive him. A short fight ensued, which resulted in favor of Parker, and the governor and his party had to take refuge in the houses, where they stood a siege of four or five hours, and then surrendered. The governor, who was badly wounded, and several leading citizens were made prisoners. The raiders found in the treasure-house booty to the value of 10,000 ducats, and elsewhere in the town large quantities of plate, merchandise, and money were secured. Beyond burning a few negro huts as a warning, the pirates did no damage to the town, and having fairly divided the booty and released the prisoners without ransom, Parker and his men, on two Spanish ships that they found in the harbor, sailed down the river and, determinedly returning the fire of the forts, got safely away.

More formidable and more bloodthirsty were the next foemen by whom Tierra Firme was threatened. All the bands of sea-rovers or pirates, English, French, and Dutch, who followed in the wake of the Spaniards, made the various harbors of Santo Domingo favorite places of call, because wild cattle were plentiful in every part of the island and ships could there be revictualled at very little expense. The places where the flesh of the cattle was dried were called "boucans," and from this word was derived the term boucanier or buccaneer, the name by which those raiders of the seventeenth century are now universally known. About 1630 the little island of Tortuga became the headquarters of the buccaneers. In 1640 they amounted to 300 men, and then for the first time selected a leader. The Spaniards, whose dominions they devastated, naturally looked upon them as enemies, but by the other European powers they were secretly regarded, and sometimes openly treated as allies and friends. In fact, when Cromwell's British troops captured Jamaica in 1655, they were materially helped by a large force of buccaneers.

The buccaneers were generally men of ferocious mien and mind. In their early history a few of them stand out in a proud preëminence of wickedness and crime, such as Montbar, Pierre le Grand, and Bartolomé Portuguez; but the most dreaded cutthroat of them all, an arch-fiend in cruelty and ferocity, was Francois L'Olonnois. Luckily, for the purposes of this narrative, we have not to chronicle the performances

of L'Olonnois further than to say that, after a revolting career, it was in Darien that he met his end. In or about 1665 he was obliged to go ashore in search of provisions, and he and all his party save one fell into the hands of the natives and were roasted alive. As the English translator of Esquemelin puts it, "The Indians tore him in pieces alive, throwing his body limb by limb into the Fire, and his Ashes into the Air, that no trace or memory might remain of such an infamous inhuman Creature."

Another celebrated buccaneer was Mansvelt. About the year 1664 Mansvelt planned to sack Natá by reaching it overland from the Caribbean. He first captured the island of Santa Catarina, where he planted a buccaneer settlement and left it in charge of one St. Simon, a Frenchman. He then proceeded to his attack on Natá, but found such extensive preparations made by the president of the audiencia of Panama to defend it that he had to give up his attempt as impracticable. He then turned his attention to Cartago, the capital of Costa Rica, but here again he was foiled. On his return he found his colony on Santa Catarina flourishing and every preparation made to retain permanent possession. Successive appeals to the governors of Jamaica and Tortuga to aid him in a further attack on Cartago proved unavailing, and Mansvelt died soon after. In August the president of Panama recovered with but little difficulty Santa Catarina from the buccaneers.

Second in command to Mansvelt in his attempted raid was Henry Morgan, whose name, to English-speaking people at least, is perhaps better known than that of any other buccaneer. Morgan was Welsh by birth and belonged to a respectable family in comfortable circumstances. Embarking while still a mere lad on board a ship bound for Barbados, he was sold as a slave by the ship's master when the vessel touched port. Having contrived to escape, he made his way to Jamaica, where he joined a party of raiders who were about to start for the Spanish West Indies. With the gains of this and other similar expeditions, he was enabled to purchase part ownership of a vessel, of which he was elected captain, and in which he made a paying trip to the coast of Campeche. It was on his return that he was appointed vice-admiral of Mansvelt's fleet. On Mansvelt's death, Morgan was elected captain-general of the buccaneers, a position which gave him control of twelve ships and seven hundred men. A raid on Puerto Principe in Cuba not proving financially profitable, Morgan turned his attention to Tierra Firme, on the coast of which he appeared with nine ships and four hundred and sixty fighting men in June, 1668. A night attack was then planned on Porto Bello. Having first taken and blown up the castle of Triana with its defenders, he advanced on the town itself, of which, after some desperate hand-to-hand fighting, he had gained complete possession by evening of the following day. The scenes that ensued are beyond description. Having secured their prisoners, who were nearly all wounded, in a building in which they had neither food, water, nor attendance, the victors gave themselves over to every species of rioting and debauchery. Matron and maid and religious recluse were alike the victims of the pirates' cruel lust. The following day was devoted to the plunder of the churches and the houses and to the taking of more prisoners. The town was held to ransom for 100,000 pesos. A force of 1,500 men, sent to the rescue by the president of Panama, was defeated and routed by 100 picked men sent against them by Morgan and posted in a narrow defile through which the relieving army had to pass. For fifteen days Morgan held Porto Bello, and then, having received the stipulated ransom and taken the best guns of the fortresses and spiked the remainder, he and his men took their departure. At Cuba, to which they steered, a distribution of spoils took place. The coin, bullion, and jewels were valued at 260,000 pesos and there were besides large quantities of silk, linen, cloth, and other merchandise.

This notable exploit added so much to Morgan's reputation that crowds of recruits, French as well as English, began to swarm to his standard, and soon he had at his command a flotilla of fifteen vessels and 960 daredevil fighters. With these he made forays on Maracaibo and Gibraltar in the modern Venezuela, retiring therefrom with plunder to the amount of 250,000 pesos, in addition to merchandise and slaves.

Morgan's next and last, as well as his greatest, pirateering exploit was the sack of Panama. For this expedition his ranks were swelled with recruits from Jamaica, and when he assembled his forces at Cape Tiburon, he had thirty-seven ships and 2,000 combatants. Each vessel carried cannon varying in number from four to thirty pieces. Morgan took the title of admiral, flew the royal standard of England on his flag-ship, and proceeded to make war in regular fashion on Spain in her new world dependencies. His first attempt was to capture Santa Catarina once more, and without much difficulty he succeeded in gaining possession of it and of a well fortified adjacent islet on December 21, 1670. Thence he dispatched Captain Bradley with five ships and 400 men, and instructed him to capture Fort San Lorenzo at the mouth of the Chagre. This was a difficult task, for, as we have already seen, San Lorenzo was admirably planned for defense, and just then it was garrisoned by 314 well armed veterans and a number of skilled Indian archers. But there was no resisting the onslaught of the buccaneers. After a fierce fight, in which luck greatly favored the attacking party, the fortress fell. The fatalities on both sides were numerous. Of the garrison of San Lorenzo only thirty were still living when Bradley made his last and successful advance to storm the walls.

As soon as Morgan learned of Bradley's success he came up with the remainder of his ships and men, and leaving a force of 500 to guard the castle and 150 to guard the fleet, he started overland for Panama with some 1300 adventurers. The way was long and toilsome, and great were the sufferings of the buccaneers from the inclemency of the weather as well as from hunger and fatigue. At one time they had to be content with a diet of dried hides; at another they were glad to kill some dogs and cats to eat. At length after a terrible nine days' march they came in sight of the city of their quest. Next day the Spanish forces to the number of 400 horse and 2,400 foot, with some few pieces of artillery, were drawn up to oppose them on a plain in front of the city. The ensuing battle was fast and furious, and in two hours victory rested with Morgan and his men. The city was then easily taken. The loot found was not very great, being confined principally to a few gold and silver utensils, concealed in wells, and to silks and cloths, of which there was a considerable quantity, but most of the citizens had fled to the adjacent islands taking with them everything that could be conveniently carried. No sooner were the buccaneers in possession than several of the largest houses were seen to be in flames, and, despite all efforts on the part of both the raiders and the inhabitants to check the progress of the fire, practically the whole city was burned down before midnight. Disappointed in the booty secured, Morgan determined to remain at Panama in order to search the surrounding country, sea, and islands, and bring in whatever valuables could be found and as many prisoners as could be taken with a view to their subsequent ransom. After holding his ground for four weeks he started on February 24, 1671, for San Lorenzo, with six hundred prisoners and 175 pack-animals carrying the spoils. When it came to a division of the booty, there was much heart-burning, for each man received but 200 pesos, whereas a portion of 2,000 or 3,000 pesos had been expected. They strongly suspected that Morgan had by some trick managed to secure a grossly disproportionate amount of the more valuable articles for himself, and the commander, doubtless well aware of the correctness of the surmise and fear-

ing for his own safety and for the security of his ill-gotten gains, stole away by night with only three or four vessels and made for Jamaica, where he duly arrived. He there engaged in the formation of plans for other piratical adventures, but the political situation had changed, peace had been made between England and Spain in 1670, the treaty of Madrid, which recognized the English possession of Jamaica and other territory in the western hemisphere, had been signed, and a new governor had been sent to that island with instructions to see that the provisions of the treaty were strictly enforced. Morgan's pirateering plans were thus perforce brought to a premature end; but the new state of affairs probably suited his purpose just as well. Taking advantage of the promulgation of a general pardon and indemnity for all past offences, he went to England, where he was knighted, appointed a lord of the admiralty, and finally deputy governor of Jamaica. In this latter capacity he used a strong hand in putting down such raids as those in which he had himself once taken so active a part.

Those of his followers, to the number of 700 or 800, whom he had left in the lurch at San Lorenzo soon found themselves in a pitiable plight. Their only resource to save themselves from absolute starvation was to pillage the shores of Castilla del Oro, and having done this pretty thoroughly, they returned to Port Royal in Jamaica, with very little to show for their celebrated sack of the wealthy city on the Pacific shore.

When the court of Spain learned of the destruction of Panama, orders were at once issued to have a new city built in a situation where it could be strongly fortified. The site selected was on a peninsula at the foot of the hill of Ancon about two leagues to the west of the old one, and here a city almost in the form of a square was planned. The foundations were laid in 1573. A deep moat, with entrances through three massive gates, separated the city from the mainland. A wall ten feet wide and varying in height from twenty to forty feet, and provided with forts and watch towers at frequent intervals, was carried clear around the city. On the side of the sea coral reefs running out for fully half a mile prevented the near approach of any large vessel even at high tide. It is related that so long were the walls in building that on one occasion the Spanish king, being asked why he looked so earnestly toward the west out of a window in one of the upper rooms in his palace at Madrid, replied that he was trying to see the walls of New Panama, which, he added, were so expensive that they ought to be high enough to be visible from Europe; and when the Council of the Indies had audited the accounts, they issued the sarcastic inquiry whether the fortifications were of silver or of gold. Whatever their cost, the fortifications were good and enduring and served their purpose well, for during Spanish occupation Panama was never sacked again.

Despite treaties of peace and international agreements, it was not to be expected that lawless men like the buccaneers would suddenly abandon their favorite enterprises. Nor did they. In 1679 Porto Bello fell again a prey to pirates, who despoiled it of several thousand pesos' worth of booty. These same desperadoes then joined themselves to a still larger force, and made a league with the natives of the Samballas or San Blas islands and the Darien Indians for the purpose of once more attacking Panama. Under the guidance of the cacique Andrés, whom they styled the emperor of Darien, they sailed with seven ships and 366 men from Golden Island, and on April 5, 1680, landed on Darien under the supreme command of Captain Bartholomew Sharp. Accompanied by their allies under Andrés, they first marched on Santa María, because that was the place where was stored the gold from the adjacent mines for subsequent transportation to Panama. On the way they were joined by another friendly cacique, and further on they came to an Indian village where resided Andrés's son, Antonio, who, from his usual head-gear, received from the freebooters the sobriquet

of King Golden-Cap, and who joined them with 150 of his followers. They arrived at Santa María at dawn on April 15 and after a short struggle, which the buccaneers mostly carried on with their cutlasses, scarcely using their firearms at all, overmastered the garrison of 260, and took possession of the place. Unfortunately for them a shipment of gold to the weight of 300 pounds had been made to Panama a few days before, so that very little booty was forthcoming. They held the town for two days and then gave it over to the flames.

From this point there was some hesitation about advancing, and in order to secure unanimous action Captain Coxon was elected to the supreme command. Then in thirty-five canoes and a piragua they proceeded by way of the Santa María River to the Gulf of San Miguel. One section of the pirates, to the number of sixty-eight, in a piragua and some canoes was attacked on reaching the Bay of Panama on April 23 by three Spanish men-of-war, and a hot fight lasting from sunrise to noon resulted in the defeat of the Spaniards and the capture of two of their warships. The victors then made for the Island of Perico, where they found five ships lying at anchor and abandoned. Two of these they burned, one they used as a hospital for their wounded, and the other two they appropriated for other purposes. They also burned the warships which they had taken in the battle. Captain Sharp, who had gone to the Pearl Islands for water and there captured a brigantine, to which he transferred his crew, was delayed by contrary winds and therefore was absent from the action, but he joined his comrades two days later.

The freebooters remained for about ten days before Panama, during which time Coxon with about fifty men set sail with the intention of going back to the North Sea. He was accompanied by Andrés and Antonio and the other Darien chief. Those left behind sailed on May 2 under Captain Sawkins, who had been appointed to succeed Coxon, to the island of Taboga, established a successful blockade of Panama, and made prize of several vessels. From Taboga they went to Otoque and thence to Quibo, the modern Coquimbo, off the coast of Veragua. From Quibo Sawkins with sixty men made an attack on Pueblo Nuevo, but lost his life while heading a charge, and the attempt on the settlement proved a failure. Following this Sawkins's men, to the number of about seventy, and the remaining Indians left for the purpose of recrossing the Isthmus.

Sharp was now once more in command, and with the 146 men still remaining undertook a cruise southward. They plundered many towns, captured many Spanish vessels, and secured immense booty. Another dispute having arisen as to whether they should return or continue southward, Sharp was again deposed and John Watling put in his place. Sailing northward once more, they made an unsuccessful attack on Arica, which cost Watling his life. It was then proposed that Sharp should be again appointed to command, but on this question there was a great division of opinion, and it was finally agreed to put the matter to a vote and to allow the minority, if dissatisfied, to take the long boat and canoes and go where they chose. The majority was found to be on the side of Sharp, and the minority, to the number of forty-seven, under William Dampier made their way to the isthmus, intending to return overland to the Atlantic. Sharp continued his northward course, but did not try to molest Panama. He sacked and burned Esparza, where he took many prisoners, and then turning southward once more, he captured the San Pedro treasure ship with 37,000 pesos, and plundered, burned, and destroyed all along the coast of South America. Rounding Cape Horn safely he arrived at the Island of Antigua on February 1, 1682. There the crew dispersed, and those who could manage it took ship for England. Arrived there, Sharp and some of his followers were, at the instance of the Spanish ambassador, put on trial for piracy. Their defence was that they had for their





RAIDS OF THE BUCCANEERS

1. Sir Henry Morgan.
2. Sacking of Porto Bello. — From Esquemeling, 1700.
3. Morgan's attack on Panama. — From Esquemeling, 1700.

acts the authority of commissions from the independent caciques of Darien, who, as they strongly urged, were by no means subjects of Spain. Either on this plea successfully sustained or in default of evidence sufficient to convict, they secured a verdict of acquittal.

Dampier and his forty-six comrades, who had seceded from Sharp's party at Arica, succeeded after incredible toil and hardships in crossing the isthmus in twenty-three days with the loss of only one man. Rowing over from the mouth of the Concepcion River to La Sound Key, one of the Samballas group of islands, they were there taken aboard a French privateer, and their wanderings were thus brought to a temporary end.

A surgeon, Lionel Wafer, who was one of Dampier's party, was wounded by an explosion of gunpowder, and with four others remained behind in an Indian village, where they were kindly treated and Wafer was carefully nursed back to health. They remained for several months among the Indians, but eventually rejoined some of their comrades in the West Indies. Wafer learned the language of the natives and noted their occupations and customs, as well as the physical features of the country, and gave to the world the record of his experience and observations in his interesting "New Voyage and Description of the Isthmus of America," which was published at London in 1699.

Dampier had evidently an adventurous and roving disposition, for we find him in August, 1683, engaging in a buccaneering expedition under Captains Cook and Eaton, which, on reaching the western coast of South America, was swelled by new arrivals, French and English, at different points. On the death of Cook off Cape Blanco in Costa Rica Captain John Davis received the command. The history of this expedition is very interesting, but for the purposes of the present narrative only one or two points in connection therewith seem to require notice.

The first was the engagement of the buccaneers with the Spanish treasure fleet outside Panama on May 28, 1685, and their failure to take it owing to a clever stratagem adopted by the Spanish admiral. The expedition having, like the one last described, subsequently split into different sections, Dampier went with Captain Swan to Mexico and thence across the Pacific to the Ladrone Islands and the Philippines. Here there was a mutiny, and Swan, with some forty of his men, was put ashore on the island of Mindanao, where he was eventually murdered by the natives. Dampier landed at the Nicobar Islands and did not return to England until 1691. He afterwards engaged in other voyages of a more orthodox character, and survived until about 1712. He published at London in three volumes, 1697–1709, a fascinating account of his wanderings with Cook, Davis, and Swan, under the title of "A New Voyage Around the World."

The second matter of interest referred to above has to do with the depredations on Tierra Firme of Captain Townley and a combined force of French and English pirates under his command. Townley, who had joined the main expedition on March 3, 1685, had at first accompanied Swan when the division of forces was effected, but parted company with him off the Mexican coast, and had then fallen in with the French captain Grogniet and joined him in April and May, 1686, in attacks on Granada, Realejo, and Chinandega, all of which places they took without securing much booty. On the 9th of May the commanders separated, and Townley and his band of Frenchmen and Englishmen made on their own account a descent on Villa de los Santos on the Rio Cubita, where they secured loot in money and merchandise to the value of over 1,500,000 pesos, besides taking 300 prisoners. On their return to the shore with their spoils, they were ambuscaded several times by the Spaniards and suffered many losses in killed and wounded, and had the further mortification of seeing their booty recaptured. Finally negotiations were entered into, and

the prisoners were ransomed. The buccaneers then proceeded to the Pearl Islands, and for two months terrorized the whole Bay of Panama, capturing numerous vessels with great slaughter, and descending on the land almost at will. In one naval engagement Townley was mortally wounded and died on September 8, 1686. His followers devoted themselves for the remainder of the year to depredations on the coast of Veragua and in the adjacent islands and bays. Joined once more by Grogniet early in 1687, they harassed the shores of South and Central America and Mexico, and then, having acquired great wealth, they decided to return to the Atlantic Ocean, enjoy their riches, and take their ease. Starting out 280 strong on January 2, 1688, they made a famous march overland from Segovia to Cape Gracias á Dios, encountering and overcoming on the way great dangers alike from man and nature; reached the Atlantic on March 9; and succeeded in gaining the French and English settlements in the West Indies, where they were finally dispersed. One of them, Raveneau de Lussan, published at Paris in 1689 his account of the events of the expedition under the simple title of "Journal d'un Voyage."

The last piratical affair of importance with which we are called upon to deal occurred in 1726, when the mestizo, Luis Garcia, was commissioned by the governor of Panama to employ Indians for the purpose of wiping out the French filibusters, whose devastations on the coast of Tierra Firme were still continued. The result was the victory of Garcia, the death of Petitpied the leader of the French, and the break-up of his marauding band. Encouraged by his success, Garcia himself then turned traitor to the Spaniards, and persuading some of the caciques of Darien to throw off Spanish allegiance and form a government of their own, he began an insurrectionary campaign, in which at first he made ready progress, marching from the River Yavisa to Santa María, killing and despoiling as he went. Santa María itself was also taken and burned. These proceedings naturally aroused considerable alarm, and the president of Panama sent out a body of picked men to suppress the revolt. At the same time he offered to reward any one who would bring in the body of Garcia, dead or alive. This proved to be an excellent tactical move, for the mestizo perished at last ignominiously at the hands of a negro. With the death of the leader the insurrection was suppressed.

The trend of political affairs in Europe: the Peace of Ryswick in 1697; the ascent of the Spanish throne by Philip V., the first of the Bourbon dynasty, in 1700; the War of the Spanish Succession from 1702 to 1713; and the Treaty of Utrecht in the last mentioned year: all tended to disintegrate the buccaneers. In particular, the feelings of antipathy between the French and the English nations, which the great twelve years' war with its varying fortunes did so much to arouse and maintain, hastened the snapping of the bond of union that had hitherto linked French filibuster and English privateer in one common cause under the common name of buccaneers. But, in addition to all that, the policy of the buccaneers, being based primarily on destruction, did not contain in itself the elements of permanency, and was bound sooner or later to bring their great but loose-jointed organization to an end. The pressure of outside affairs served only to hasten its inevitable collapse.

CHAPTER X

THE DARIEN SCHEME

William Paterson—His Early Life—Proposes the Darien Scheme—Founds the Bank of England—Revives the Darien Scheme in Scotland—Opposition in England—Enthusiastic Support in Scotland—The First Expedition—Founding of New Edinburgh—Action of the Spaniards—Action of King William III—Failure of the First Expedition—Abandonment of New Edinburgh—The Second Expedition—Its Failure—The Third Expedition—The Scots Defeat the Spaniards—Siege of New Edinburgh—Its Capitulation and Surrender—End of the Darien Scheme—After-Career of Paterson—His Death—His Character.

THE possibilities of Panama, or at least a portion of it, as a great commercial entrepôt for the trade of the East and the West appealed forcibly to William Paterson, who, in a wholly dispassionate view, must be allowed to have possessed one of the keenest financial minds of the late seventeenth and early eighteenth centuries. Paterson was born in April, 1658, on the farm of Skipmyre, in the parish of Tinewald, in Dunfriesshire, Scotland. He lived there until he was about seventeen years old, when religious persecution combined with natural ambition to drive him forth to seek his fortune. His mercantile beginnings were necessarily humble, and we find that he carried a peddler's pack through a considerable portion of England. He finally drifted to Bristol, then a port of great importance, and thence he shipped for America. His principal place of abode in the New World appears to have been the Bahamas. His career there is shrouded in mystery, for what he did no one can exactly tell. He is said by some to have been a preacher, by others a missionary, and by others again, a buccaneer. It is probable enough that he was something of all. From the buccaneers, in any case, as well as from personal inspection, he derived that information regarding the geography and conditions of Tierra Firme from which he evolved the vast design which is known to history as the Darien Scheme.

Returning to England, Paterson endeavored to interest the ministry in his plans, but both James II and his advisers gave him the deaf ear. He then (1687) passed over to the continent, but met with no greater success in Hamburg, Amsterdam, or Berlin. Yielding for the time, he returned to London, engaged in business, and very quickly amassed a fortune. He always had big things in his mind. Thus we find him, about 1690–1692, associated with two others in forming the Hampstead Water Company; and neither then nor since have promoters of waterworks engaged in their operations for philanthropy alone.

But a bigger enterprise still was soon hatched in Paterson's fertile brain. He saw that not only the mercantile community but also the government itself were in sore need of better banking accommodations than then prevailed. In any sudden emergency a public loan could not be negotiated, even on the gilt-edged security of the land-tax, at less than eight per cent. interest, and then only after much delay and urgent entreaty; but the rate was more usually ten or twelve than eight. To change conditions so irksome, Paterson had already proposed the foundation of a national bank in 1691; but the "interests" of that day, accustomed to fatten on usurious profits and enraged at anything that threatened their monopoly, were powerful enough to have the matter postponed. Paterson, however, knowing how valuable his plan was and being of a

determined and persevering nature, brought his proposal before the cabinet again in 1693, and, despite a strong and even stormy opposition, it was ratified by parliament, and by charter granted under the Acts 5 and 6, William III., C. 20, the Bank of England came into existence on July 27, 1694.

As is the case with all great financial undertakings, the underlying idea of the Bank of England was extremely simple. The company advanced to the government £1,200,000 in consideration of receiving an annuity of £100,000 made up of eight per cent. by way of interest and £4,000 for expenses of management. The beneficial effects of this institution were speedily apparent, and went forward so rapidly that during the reign of George I the normal national rate of interest was only three per cent., and the government seldom had to pay more than four.

Paterson was one of the original directors of the Bank, but in less than a year he came forward with another great scheme for an "Orphan Bank," and as his fellow-directors were afraid of the competition which the proposed new institution might cause, and as in any case they were rather fearful of the able Scotsman whose brain teemed with one financial plan after another, friction ensued, and the founder of the Bank of England had to retire from its board.

At this juncture Paterson was attracted to the possibilities which seemed to be offered to a man of financial genius by his native land. The Scottish people were naturally anxious to share in the superabundant trade which at that time was rapidly enriching England. Already in 1693 the Scottish parliament, with an eye to the promotion of commerce, had passed an act under which letters patent were to be granted to all who would set up new manufactures, establish new settlements, or carry on any new trade. Taking advantage of the opening thus offered, some Englishmen, who had been trying to cut into the trade of the East India Company and had been defeated by that company in the English parliament, entered into negotiations with some Scottish merchants, who undertook to procure from their own parliament a special act for the foundation of a new colony.

This was just the opportunity that Paterson needed. He proceeded to Edinburgh, where he paraded his knowledge of America, and hinted not obscurely that he possessed a great secret, that, in fact, he knew in those distant parts a country in which there were no Spaniards, in which there were rich gold mines in plenty, and which was ideally situated for trade with all parts of the world. He did not at first name this mysterious and happy territory, but suggested that the West Indies ought to be included in the scope of the proposed bill. The result was that in 1695 an act of the Scottish parliament established the "Company of Scotland trading to Africa and the Indies." To this act William III, then in camp in Flanders, hastily gave the royal assent. Then Paterson named his promised land. It was in the Isthmus of Darien that he proposed settlements should be established both on the Atlantic and the Pacific coast, which settlements, he prophesied, should "hold the keys of the commerce of the world." To English adventurers the whole plan was so alluring that in nine days they subscribed £300,000, or half the capital stock. The scheme, indeed, was conceived on new and generous lines. Trade was to be free, ships of every nation were to have the privilege of putting into the harbors of the projected settlements, and no distinction of race or religion was to be made.

Immediately the English parliament was up in arms. The House of Lords invited the House of Commons to a conference, and a joint address was drawn up and presented to the king. This address stated that the Scottish Company was likely to cause much damage to English trade, which stood the chance of being diverted to Scotland, and that in particular the setting up of Scottish plantations in America would prove of great detriment to English com-

merce in tobacco, cotton, sugar, wool, and masts. The Commons even went so far as to pass a resolution declaring that the directors of the new company were guilty of high crimes and misdemeanors, and clamored for their impeachment. All this stirred the phlegmatic William to action, and he dismissed from office the lord high commissioner of Scotland and the two Scottish secretaries of state, and gave it to be understood that when he signed the act he had been deceived as to its true intent. This action on the part of the king gave satisfaction in England, and quieted the East India Company, which was at the bottom of the opposition. Another very practical result was that the English subscriptions were withdrawn, and a similar amount subscribed in Hamburg was, under threat from England, also cancelled.

In Scotland, on the other hand, a wave of indignation spread over the whole country at an opposition which was avowedly based on trade jealousy, and money poured in from all quarters, from the Highlands as well as from the Lowlands, in aid of a scheme which promised to promote Scottish trade, to minister to Scottish glory, and to bring confusion and dismay to the monopolists across the border. Duchesses and provosts were among the subscribers; maids paid in their dowries and widows sold their jointures to swell the company's funds with the proceeds. Altogether a sum of £400,000 was speedily forthcoming.

With part of the money an expedition was equipped. Five large vessels, freighted with merchandise, military stores, and provisions, were got ready. There was no lack of volunteers. The aristocracy sent their younger sons in the firm belief that they were thus putting them on the high road to prosperity; feudal lords and landowners stripped their estates to send out their vassals and tenantry; and many army officers, who found their former occupation taken from them by the Treaty of Ryswick concluded in 1697, volunteered for service in the El Dorado of the west. Altogether 1,200 persons embarked, and hundreds of others, mostly soldiers and sailors, were with difficulty restrained from stowing themselves away in the ships. Practically the whole population of Edinburgh poured down to Leith to witness the departure of the national argosy on July 26, 1698, and amid the blessings and prayers of the nation the ships weighed anchor and stood out to sea.

For some reason, which is not now very plain, Paterson had at first no place of honor or command, but nevertheless he and his wife and her maid, as well as a few other women, were among those who embarked. At Madeira, however, where the ships touched on August 29, Paterson was appointed on the Council to which the directors of the company had entrusted the direction of the affairs of the proposed colony. The expedition had more than average good luck, for on the voyage only forty-four of the intending colonists died. After sundry calls on the way the fleet at length anchored off Golden Island. They landed on the mainland on November 3, took possession, and started a settlement, to which they gave the name of New Edinburgh. A little fort erected to command the harbor with a battery of sixteen guns they called Fort St. Andrew. The country was named Caledonia, and the harbor and surrounding water became known as Caledonia Bay. Friendly relations were at once established with the neighboring native chieftains, and treaties of friendship, union, and perpetual confederation were entered into with them.

These proceedings naturally aroused the ire of the Spaniards. The Spanish ambassador at London committed to writing a formal protest, and the governor of Panama and Cartagena took the more practical step of gathering land and sea forces to expel the interlopers. Partly to conciliate Spain, and partly to placate his English subjects at home and in the New World, King William III issued orders to the governors of Virginia, New York, New England, Jamaica, and Barbados, directing them to refuse food or other assistance to the Darien colonists, and to make proclamation pro-

hibiting their people from holding any communication with them.

Against the effects of these prohibitions and proclamations the Scottish colonists might in time have made headway, and with the aid of the Indians they might have been able to repel the attacks of the Spanish settlers; but other causes were at work to bring about their downfall. About three hundred of them belonged to the gentleman class, and were as unfitted for manual labor as they were unaccustomed to it and scornful of it. The others, hardy sons of a northern clime and willing enough to work, were unable to cope with the temperature of the tropics. The councillors were incompetent and were continually quarrelling among themselves. No word of any sort reached them from the directors of the company in Scotland; and that was discouraging. Their Indian allies, remembering the exploits of the buccaneers, were disappointed and disgusted on finding that so large a force did not proceed at once to attack the common foe, and were continually bringing in alarming reports of the threatening movements of the Spaniards. Scarcity of provisions led to disease, and disease brought on death, among the victims being Paterson's wife. Utterly discouraged and dismayed, alike by their experience and their prospects, the colonists, having lost more than a quarter of their original number, finally determined to abandon their ill-starred enterprise, and sailed for New York, en route for Scotland, on June 20, 1699. The last man to embark was Paterson, and, as he was suffering from a fever, he had to be carried on board, protesting vehemently all the time against the too hasty evacuation of New Edinburgh. On the way 400 died, and the survivors made their way back to Scotland in one out of the five ships on which a few months earlier they had set sail from Leith with such high hopes.

Paterson's protests had been unavailing; but they were justified. It was a pity that the Scottish colonists did not hold out a little longer than they did, for at the very moment they abandoned their settlement relief was on the way. Towards the end of December, 1698, the first report from the colony had been despatched home in charge of Alexander Hamilton, and as it brought the welcome intelligence that the colony was established, that no disaster had been incurred, and that few deaths had taken place, it was received with great satisfaction, thanksgiving services were held in the churches, and the populace manifested its joy by bonfires and the ringing of bells. A vessel with supplies was equipped and sent out, but it was wrecked on the Scottish shore. Two other ships with 300 recruits and plentiful supplies were next hurried off in May, and reached Darien safely in August, only to find New Edinburgh deserted and their fellow countrymen departed.

This second expedition had exceptional good luck on the way out, for only one man died, but after they arrived, disaster came upon them rapidly. Despite the absence of the large number of colonists whom they expected to find, they had decided to remain in possession, in the expectation of succor from another relief party which they knew was being prepared at home; but of their two ships that one which contained most of their supplies was accidentally destroyed by fire. This calamity decided them in turn to abandon Darien, and they sailed for Jamaica, where many of them sickened and died. Twelve venturesome spirits remained behind at New Edinburgh to await the arrival of the third expedition.

That expedition, the largest of them all, was speedily on the way. It consisted of four ships, with 1,300 persons and an ample supply of provisions. It left Scotland on September 24, 1699, and after losing 160 lives on the journey, reached Caledonia Bay on November 30. There they found a member of the first colonizing party in the person of Captain Thomas Drummond, who had returned in a sloop from New York to take a hand in the resettlement of Darien. The twelve sturdy leftovers from the second expedition were also located, liv-

ing peaceably among the Indians. The new colonists landed, cleared the ground, built new huts, and renewed friendly relations with the natives. But the new councillors were no improvement on the first, plots were formed against them, and dissension prevailed. Disease and death were rife, and always there was danger from the enraged Spaniards. Drummond, whose acts bespeak him a man of spirit, offered to take 150 volunteers and some Indians and proceed to attack the Spaniards in Porto Bello. But the dominant mind in the council was that of James Byres, a fanatic who held that it was unlawful for Christians, under the New Testament dispensation, to make any war, and accordingly the council, far from listening to Drummond's courageous proposal, had its author arrested and put in chains on some trumped-up charge of concocting a plot to seize the vessels and sail away.

Matters were thus on a precarious footing when Captain Alexander Campbell, who had been appointed by the directors governor or commander of Caledonia by land and sea, arrived at New Edinburgh in February, 1700, with a sloop full of provisions. Campbell first released Drummond from his chains, and then set out with 200 Scotsmen and forty Indians to do battle with the Spaniards, whom his native scouts reported to be coming. The opposing forces met at a place called variously Yoratuba and Topocanté. The Spaniards, with mulattos, creoles, and negroes to the total of 300 or 400, under the command of Miguel de Cordoñez, had barricaded themselves on a hill, but the Scots carried the palisades with a rush, and, after a hot engagement, the Spaniards fled.

This initial success seemed to be of good augury for the new governor's administration; but the danger sprang from an unexpected quarter. On February 25, eleven Spanish sail appeared in the offing and drove in the boats belonging to the settlement. Troops also came up overland from Panama and Santa María. The result was that the Darien colonists were closely beleagured by land and sea. To add to their miseries there was great sickness among them and many deaths ensued, and both provisions and ammunition ran low. They were thus from every point of view in a pitiable plight, and they were therefore very glad when the Spanish general, Don Juan Pimienta, governor of Cartagena and Panama, sent them word on March 30 that he wished to treat with them. A capitulation decidedly favorable to the Scots was arranged. They were given fourteen days to take their departure from Panama, and it was expressly agreed that they were to be allowed to retain their arms and to go forth with drums beating and colors flying. The arrival of another Scottish sloop, the *Speedy Return*, in no wise altered these arrangements, and on April 11, 1700, the discomfited and dispirited colonists sailed away from New Edinburgh. They were so weakened that the Spaniards had to assist them in hoisting the sails, especially on the big sixty-gun ship the *Rising Sun*. Campbell and Drummond eventually got back to Scotland in their respective sloops, but disaster befell the other vessels, and all of them were wrecked; and of the original 1,300 persons whom they brought out only 360 survived, to be absorbed, for the most part, among the various English settlements in the West Indies.

A final effort to sustain the Scottish colony was made by the sloop, the *Margaret of Dundee*, which left Scotland on March 9, 1700, and arrived in Caledonia Bay on June 16; but her captain, one Patrick MacDowall, finding the Spaniards in possession of town and fort, fired a few shots by way of defiance, ran up his colors, and sheered off to Jamaica.

Thus ended in death, disaster, and defeat the Scottish attempt to settle Darien. Its originator, Paterson, lost his reason on the way home, but he soon recovered, and his fertile brain was forthwith at work on new schemes. His first care was to try to prevent the final abandonment of the Darien colony, and his next to try to have it revived; but circumstances were too strong

for him and he had to accept the inevitable. He then became an ardent advocate of a parliamentary union between England and Scotland, and when, in 1707, that union was effected, he was elected a member of the united parliament for the Dumfriesburghs. One of the last acts of the Scottish parliament was to recommend him to Queen Anne for compensation for his services, losses, and sufferings. After long delays, a grant of £18,241 was made to him by way of indemnity by the British parliament in 1715. He lived in London from 1701, and died there January 22, 1719.

Paterson's writings on finance, the union between England and Scotland, colonial enterprise, trade, administration, and sundry social and political questions, amounting to twenty-two publications in all, show him to have had a wonderful grasp of affairs, and in most respects to have been a long way in advance of his time. He suffered, too, as many original minds have suffered before and since, from the purloining of his ideas, and the credit of many of his proposals was given to others. Very appropriately therefore there is affixed to the only picture of him that has come down to us the inscription, "*Sic vos non vobis.*" The crowning calamity to his posthumous fame is that his name is principally associated with a great colonization project which failed, but which, if his monitions had been regarded and if it had not been hampered and baffled by English trade jealousy, might easily have realized his dream of putting into British hands at an early date the keys of the commerce of the world.

CHAPTER XI

THE ENMITY OF ENGLAND

CROMWELL AND SPAIN—PENN AND VENABLES TAKE JAMAICA—OPERATIONS OF BLAKE—TREATY BETWEEN ENGLAND AND SPAIN—CARDINAL ALBERONI AND BRITISH TRADE—HOSIER'S EXPEDITION—ITS DISASTROUS RESULTS—EXCITEMENT IN ENGLAND—TREATY OF SEVILLE—FURTHER BRITISH COMPLAINTS—ATTACKS ON WALPOLE—BRITISH TRADE WITH PANAMA—"JENKINS'S EARS"—WALPOLE'S NEGOTIATIONS—THEIR FAILURE—VERNON SENT TO PORTO BELLO—WAR PROCLAIMED—OGLE AND CATHCART SENT TO JAMAICA—ANSON SENT TO THE PACIFIC—DOMINION OF SPAIN IN AMERICA THREATENED—VERNON TAKES PORTO BELLO—REJOICINGS IN ENGLAND—CAPTURE OF FORT SAN LORENZO—REPULSE OF THE BRITISH AT CARTAGENA—VERNON FAILS TO MARCH TO PANAMA—HIS RECALL—ANSON'S PROCEEDINGS—HIS ACTIONS IN THE PACIFIC—HE CAPTURES A TREASURE SHIP—HIS CIRCUMNAVIGATION OF THE GLOBE—PEACE OF AIX-LA-CHAPELLE—TREATY OF MADRID—FIRES IN PANAMA—PEACE IN TIERRA FIRME—TROUBLE IN DARIEN—OPERATIONS OF ARIZA—DARIEN INDIANS UNSUBDUED.

THE antagonism between England and Spain, which had been marked during the reign of Queen Elizabeth and had flared up into mostly impotent manifestations once or twice under her two immediate successors, swelled into considerable volume in the time of the Commonwealth and again during the first half of the eighteenth century. In the plenitude of his power Lord Protector Cromwell demanded from Spain that no Englishman should ever be subject to the Inquisition, and that there should be free trade for all Englishmen with the West Indies and the South American continent. When the Spanish representative in London replied that such a demand was tantamount to asking for the King of Spain's two eyes, Cromwell, whose favorite dictum was that a ship of the line was the best ambassador, sent forth a gallant fleet under Penn and Venables, which, with the aid of the buccaneers, as already noted, took Jamaica in 1655, and made it, what it has ever since remained, a British possession. In September, 1656, one of the captains serving under Blake, the great English admiral and general at sea, captured a part of the plate fleet, and in the following April Blake himself with twenty-five ships ran in under the guns of the seven forts and the castle of Santa Cruz in Teneriffe, and demolished the plate fleet of that year which was lying at anchor in the bay.

In the reign of Charles II, after the English troops had materially helped the Portuguese to defeat the Spaniards, under Don John of Austria, at the great battle of Evora, there was concluded (1667) between England and Spain a treaty of commerce and navigation. This treaty was renewed by the Peace of Utrecht in 1713; but in 1717 when Cardinal Alberoni, the Spanish prime minister, was thwarted in the prosecution of his ambitious schemes for his adopted country by his failure to interrupt the good understanding between King George I and the Emperor Charles VI of Austria, he suspended the execution of the commercial treaty and permitted various vexations to be practised upon English merchants trading with Spain and her colonies. In 1720 the Assiento was conferred by the British government on the South Sea Company, and was one of the assets on which the gambling in the company's stocks which took place that year was based. War was formally declared by England on Spain on

December 17, 1718, and, after many disasters to the latter country, peace was made by the treaty of Madrid, June 13, 1721.

But the shifting policy of Europe did not allow the status thus established to be of long duration, and after Spain and Austria had combined against France and England in 1725, a British fleet under Rear-admiral Hosier was dispatched in 1726 to the West Indies, with orders to take or block up the Spanish galleons containing the treasures from Peru, the Isthmus, and Mexico. This proved to be one of the most fatal expeditions that ever left the shores of England. The ships had been badly provisioned and appointed, and some of them, already unseaworthy before they sailed, rotted and went to pieces in foreign waters. Hosier himself and a considerable number of his men perished miserably of yellow fever and other diseases off Porto Bello and the Spanish Main. In 1727 on the signing of preliminaries of peace in June, the British government recalled its ships from the blockade of Porto Bello, and thus allowed the plate fleet to return to Spain.

King Philip, however, did not ratify the preliminaries or relinquish any of his pretensions, and England and Spain continued in a dubious state between peace and war. By 1729 Spain, in fact, had interrupted the trade which had for some time been carried on by connivance, though not by actual permission, between the British colonies and the West Indies and the Spanish dominions on the South American continent, and the merchants of London and other English centers of business, suffering in their turn from this interruption, vented their complaints in petitions to parliament. The commons agreed in a declaration (1729) that the Spaniards had violated treaties, and also in an address desiring that King George II would be pleased to use his utmost endeavors to procure a just and reasonable satisfaction for these injuries, and to secure to his subjects the free exercise of commerce and navigation to and from the British colonies in America. The consequent representations resulted in the Treaty of Seville, November 9, 1729, by which Spain joined in a defensive alliance with England, France, and Holland, confirmed preceding treaties, revoked the exclusive privileges granted to the subjects of the emperor by the Treaty of Vienna, put the English trade in America on its former footing, restored all captures, and confirmed the Assiento.

In 1733, on the meeting of parliament, complaints were made that Spain had not yet made satisfaction for the depredations which had been committed upon British merchants during the last quarrel, and King George was obliged to confess that the meetings of the commissioners of the two crowns had been delayed, and that he could give no perfect account of their proceedings. The fact was that the Spanish court claimed that all or most of these British merchants had been engaged in an illicit trade to the Spanish Main, and, according to their principle, nearly all trade, except that in negroes licensed by the Assiento, was smuggling.

By 1738 public opinion in England was highly inflamed against Spain. Sir Robert Walpole, the British prime minister—"the cur-dog of Britain and spaniel of Spain," as he had been most unjustly called by Bishop Atterbury—was attacked by his opponents in parliament on the ground that he had not protected a trade which really amounted to smuggling, that he had not put down the guarda-costas in the West Indies, and that he had not declared war to compel Spain to admit the principle of free trade to her American colonies. Those attacks on the Minister were, of course, entirely political in their nature and were wholly unreasonable, for both by the general law of nations, which gave every independent power the right to regulate its trade and its colonies in its own way, and by recent as well as old-standing treaties, which recognized this right and in express terms required England to assent to the Spanish regulations in the New World, Walpole had been plainly prevented from pursuing the

course which he was now so glibly denounced for not adopting. If the treaty of 1670 on the one hand confirmed to England the possession of her colonies in North America and the West Indies, on the other it expressly provided that no British ship should approach the Spanish colonies in South America, unless through stress of weather or when authorized by a special trade license from the court of Spain. The treaty of Seville of 1729 did no more than put the matter of trading rights on its former footing. The second clause of the treaty of 1670 presupposed the right of search—a right which was exercised sometimes in a vigilant but more often in a very remiss manner. The result was that English adventurers, disregarding treaty obligations and acting very much as the buccaneers had done before them, plundered the coast towns of the Spanish colonies, and captured or defied any Spanish ships they might chance to fall in with.

The restriction as to allowing only one ship a year to trade to the Spanish possessions in America was eluded by every dodge and device which the ingenuity of British merchants could invent. They had indeed the excuse that they were supplying a keenly felt want, for the commodities they dealt in were sorely needed by the Spanish settlers, who could not obtain them so good and cheap in any other way. Accordingly English goods were found in every Spanish-American mart, and the annual Panama fair, at which the goods imported directly from Spain or supplied under license from that country were sold, gradually dwindled away until it was but a sorry shadow of its sometime greatness. As much would fain have more, the success of their illicit trading emboldened the English merchants to greater efforts, and made them more and more querulous whenever an English ship was captured or detained, or even subjected to search. Tales were invented of Spanish cruelty, and at every repetition the English people howled the louder for revenge.

The particular instance that fanned into flame the train of war that had been so long smouldering was what Edmund Burke afterwards characterized as "the *fable* of Jenkins's ears." Jenkins was master of a small vessel which plied from Jamaica, and he alleged that on one occasion, when he had been boarded and searched by a guarda-costa, he had been barbarously treated, that he and some of his crew had been tortured, and that the Spaniards had actually cut off one of his ears. All this had occurred seven years before, but in the then temper of the public mind such a consideration carried no weight. Jenkins was brought before the British House of Commons, and when he had told his tale and was asked how he felt under the inhuman treatment to which he said he had been subjected, he replied: "I recommended my soul to God, and my cause to my country." This answer electrified the nation and at once stirred it to ungovernable wrath. The irony of the situation is that, as is now generally believed, either Jenkins had both ears on, carefully concealed by his wig while he was giving his evidence, or, if he had really lost an ear, he had lost it as a felon in the pillory of England.

In face of all the storm Walpole, who loved peace, stood firm, and still endeavored to bring about an arrangement by negotiation before having recourse to war. But the two plenipotentiaries whom he sent to Madrid for the purpose found the Spaniards indisposed to ratify a convention made in January, 1739, for the indemnification of losses sustained by English merchants, and there seemed no prospect of an accommodation. Walpole accordingly issued in July letters of marque and reprisal, and, accepting a rather boastful offer of his enemy, Edward Vernon, to take Porto Bello with a squadron of only six ships, sent him, as vice-admiral of the blue and commander of the fleet in the West Indies, to that enterprise with the force he had named. Next, as a last resort as well as an ultimatum, Walpole de-

manded an absolute renunciation forever of the right of search and an express acknowledgment of all the British rights and claims in America. Those demands Spain rejected with all her old pride, and on October 19, 1739, war was proclaimed in London. The exultation of the populace knew no bounds: they ran through the streets shouting wild huzzas and rang the church bells as one method of expressing their joy. "They may ring the bells now," said Walpole, "but they will soon be wringing their hands."

The thing to do, however, was to make the war operations as effective as possible. Already in July, 1739, Vernon had sailed for America, and in 1740 Sir Chaloner Ogle, with a fleet of twenty-seven ships of the line and a number of frigates, fire-ships, bomb-ketches, tenders, hospital-ships, and store-ships, accompanied to Jamaica a large land force which was commanded by Lord Cathcart. At Jamaica they were joined by four battalions raised in the British colonies of North America. The object of this whole armament was to coöperate with Vernon against the Spanish settlements in and on the Atlantic. Commodore Anson was sent to the Pacific with a small squadron to assist Vernon by committing depredations on Peru, attacking Panama, and capturing the treasure fleet. It was confidently expected by most people in England that all these armaments would, between them, utterly overthrow the dominion of Spain in America.

Vernon, with his six ships, 2,735 men, and 370 pieces of ordnance, appeared before Porto Bello at dawn on November 21, 1739, and his fleet entered the harbor in line of battle. From daylight to dark a brisk battle was fought between the British ships and the Spanish forts. The issue was long in doubt, but eventually, after gallantly sustaining an almost point-blank bombardment, the city, the fortifications, and the ships in the harbor were surrendered to the British commander. The inhabitants were not molested, nor was the town pillaged, but some 10,000 pesos intended for the pay of the garrison were found and were distributed among the English sailors and troops. Having removed all the ammunition and the best of the cannon to his own ships, and spiked the other guns, Vernon demolished the fortifications that his batteries had left still standing, and sailed for Jamaica, where he refitted his fleet.

When the news of their fellow-countryman's success reached England the joy of the nation was boundless. London celebrated Vernon's birthday (November 12) in 1740 with public illuminations, 130 medals were struck in his honor, and he was reëlected—in his absence, of course—to parliament in February, 1741, and in the following May at a general election he was returned for three different constituencies and came near being elected by a fourth.

In the meantime the conqueror of Porto Bello had proceeded in February, 1740, from Jamaica to the mouth of the Chagre, and amused himself by committing depredations up and down the coast of Tierra Firme. In 1741 he joined Ogle's and Cathcart's forces at Jamaica, and was then in command of the greatest armament ever previously seen in those waters. He had thirty ships of the line, ninety other vessels, 15,000 sailors, and 12,000 soldiers. The capture of Fort San Lorenzo, demolished by Morgan in 1671 but afterwards rebuilt and much more strongly fortified, was easily effected, and then, toward the end of March, 1741, the whole British force bore down on Cartagena. The Spanish ships that lay athwart the harbor's mouth were soon destroyed or taken, the forts and castles on Boca Chica fell into the invaders' hands, their fleet sailed into the immense harbor, and the great outwork of Castillo Grande was abandoned by the Spaniards without striking a blow. Here, however, the success of the English ended. After a fierce and furious but unavailing attack by their land forces on Fort San Lorenzo, a council of war was called, and it was decided to abandon the

attempt on Cartagena as desperate and to go back to Jamaica.

In *Roderick Random*, Smollett, who was on this expedition, has left us a vivid picture of the famous but disastrous attack on Cartagena. The unhealthy climate had been more deadly to the men than even the guns of San Lorenzo: the 12,000 soldiers had been reduced to 3,000.

In July, in pursuance of orders from home, Vernon proceeded to Cuba, but failed again before Santiago in that island. A new reënforcing fleet of four ships of war with 3,000 more soldiers was sent to Vernon from England, but although in 1742 he sailed once more to Porto Bello, intending to land there and march to Panama, his plans were frustrated by the rainy season and by sickness and mortality among his troops, and he had effected nothing more when he was recalled. Sailing for England he landed at Bristol in January, 1743, with scarcely one-tenth of the number of men he had led from Jamaica to Cartagena.

In the meantime Anson, who with six vessels had left England in the autumn of 1640, had encountered in the Pacific a fierce storm which lasted fifty-eight days and scattered his little fleet, so that when they finally rendezvoused at Juan Fernandez in June, 1741, only three ships were forthcoming and most of the men died of scurvy. At Juan Fernandez Anson remained 104 days, and then bore up the South American coast, where he emulated the performance of the buccaneers by burning towns and villages and making prize of every vessel he met. Vernon's failure at Cartagena, which Anson learned from some of the prisoners he took, rendered coöperation across the Isthmus a practical impossibility, and so the Commodore decided to leave Panama alone. He finally started with only one ship, the *Centurion*, to cross the Pacific, and on the way he fell in with and captured a Spanish galleon on her passage from Acapulco to Manila, having on board nearly 1,500,000 pesos. Returning to England by way of the Cape of Good Hope he arrived at Spithead on June 15, 1744, having spent three years and nine months in his circumnavigation of the globe.

The total treasure he brought back amounted to £1,250,000 sterling, and this was conveyed in solemn procession from Portsmouth to London in thirty wagons guarded by the ships' crews and preceded by the officers with swords drawn, bands playing, and colors flying. It was really a great performance on Anson's part, and he was duly rewarded by being appointed rear-admiral of the blue and one of the lords of the Admiralty, with greater honors and dignities yet to come; but the treasure he brought back did not go to the nation, and, even had it done so, it would have made but poor compensation for the millions of pounds sterling and the thousands of valuable lives that the West Indian expedition of 1739–1742 had cost England.

The war dragged on in dilatory fashion until it was brought to an end by the Peace of Aix-la-Chapelle in October, 1748. By this peace England secured from Spain the concession of none of the main principles for which the war had been in the first instance undertaken—neither the satisfaction of her commercial claims, nor the abolition of the right of search, nor the free trade for British shipping with the Spanish Main. The sole gain appears to have been the renewal of the Assiento for four years. It comes, therefore, as a sort of anti-climax to learn that two years later, in a time of peace, part at least of the demand in connection with those much disputed restrictions on trade was conceded by international agreement. By the Treaty of Madrid, signed on October 5, 1750, the British were restored to sundry privileges and put on the most-favored-nation footing. At the same time they gave up the remaining term of the Assiento, and obtained for the South Sea Company £100,000 by way of compensation in lieu thereof. An extraordinary fact is that the treaty did not contain one word about the right

of search, which had been the immediate cause of the war of 1739 and of the consequent destruction of so much property and so many lives.

During all the turmoil the new city of Panama was fortunate enough to escape conquests by a foreign foe; but on different occasions during the course of the eighteenth century it received serious setbacks from disastrous conflagrations. A fire, which raged for two days and two nights in February, 1737, laid low two-thirds of the city; half of it was similarly destroyed in March, 1756; and in April, 1771, another fire wrought sad havoc among its buildings.

Outside these occurrences, the second half of the eighteenth century passed away uneventfully and fairly peaceably for Tierra Firme. To this state of affairs many causes contributed, such, for example, as the disbanding of the buccaneers, the establishment of new trade centers and routes, and the political conditions in Europe and North America. Doubtless, however, the chief cause was that falling off in importance and wealth which has been previously mentioned. The peaceful condition was on the whole an unhealthy symptom, because it was evidence of a rapid decline. The isthmian cities, ceasing to be prosperous, no longer offered rich spoils to the raider, and were therefore no longer objects of desire. For this reason, among others, Tierra Firme, as a province of New Granada, enjoyed an internal tranquillity that had been denied to it as an independent government or as a dependency of Peru, and was largely free from those struggles for supremacy and power, which, however disgraceful in themselves, made its earlier history so thrilling in fact and render it so fascinating in the reading.

There was, however, one section of the country, namely Darien, in which for a long time peace did not prevail, and in which the natives were never brought fully into subjection to Spanish rule. Missionaries failed to convert or civilize them; forts and strongholds were built among them in vain. The missionaries they derided or deceived or killed, the forts they pulled down and destroyed and put the garrisons to death. We have record of such happenings in 1751, 1756, and as late as 1773. In 1774 the governor, Andrés de Ariza, took active and skillful steps to cope with a situation that was always threatening and sometimes dangerous, and he gained greater success than any one who had preceded him; but the most that can be said of the result achieved is that his operations reduced the hostile native tribes to a sort of sullen submission that was more apparent than real. To this day many of the native inhabitants of Darien yield no allegiance to any government save their own tribal regulations, and in fact their territory is to all intents and purposes independent, and acts more or less as a buffer state between the present rival republics of Colombia and Panama.

CHAPTER XII

PANAMA REVOLTS AGAINST SPAIN

THE ISTHMUS IN 1801—ITS LETHARGIC CONDITION—FAILURE TO REVIVE TRADE—MOVEMENT FOR INDEPENDENCE—VICE-ROYALTY OF PEREZ—OF MONTALVO—ARRIVAL OF HORE—MACGREGOR'S RAID—ITS COLLAPSE—REPUBLIC OF COLOMBIA ESTABLISHED—PROGRESS TOWARDS INDEPENDENCE IN PANAMA—SAMANO'S VICE-ROYALTY —ACTION OF VICEROY MOURGEON—PANAMA PROCLAIMS ITS INDEPENDENCE—REPUBLIC OF NEW GRANADA ESTABLISHED—REVOLTS IN PANAMA—THE ISTHMUS GUARD—SUCCESS OF RAN RUNNELS—RIOTS IN PANAMA—FEELING AGAINST U. S. CITIZENS—NEW GRANADA BECOMES A CONFEDERATION—PANAMA BECOMES A STATE—PROMULGATION OF A CONSTITUTION—GOVERNORSHIP OF CALVO—OF OBALDIA—GUARDIA'S ADMINISTRATION—REVOLT IN NEW GRANADA—PANAMA JOINS THE UNITED STATES OF COLOMBIA—PANAMA PROCLAIMED A SOVEREIGN STATE—SANTA COLOMA MARCHES ON PANAMA—WITHDRAWAL OF GUARDIA—ELECTION OF MANUEL DIAZ—GUARDIA SLAIN—ADMINISTRATION OF DIAZ.

At the beginning of the nineteenth century Tierra Firme still formed part of New Granada, and was under the general sway of the viceroy at Santa Fé de Bogotá, but had its own immediate governor with headquarters in the city of Panama and with jurisdiction over the rest of the country. For administrative purposes it was divided into the three provinces of Porto Bello, Veragua, and Darien, each with its own governor, and into the two partidos of Natá and Alange, each under an alcalde mayor. There existed a judicial organization similar to that in force in other Spanish colonies, and a financial department, which included custom-houses at Porto Bello, Chagres, and Panama, a treasury with its dependencies, and the various offices in charge of the crown customs and monopolies. There was also a permanent military force stationed at the fortified towns of Panama, Porto Bello, and Chagres, at Natá, in different parts of Veragua, and elsewhere. Owing to the decline of commerce, agriculture, and mining, the public income was unequal to the upkeep of those various public services, and grants-in-aid had to be obtained from time to time from Peru. Correspondent to the depressed material state of the country, the people were also in a lethargic condition, were poorly educated, and led a care-free, ambitionless, somnolent sort of existence, easily finding means of livelihood in so luxuriant a climate, and devoting all the time they could to gambling, bull-fights, and other forms of amusement.

An attempt was made to give a fresh impetus to trade by the reëstablishment of the casa de contratacion de Indias, in January, 1803, and hopes were entertained that, as a result of this proceeding, Panama would once more become an important port of call and commercial center. But those hopes proved illusory, for during that year not one ship came from Spain, and the trade that was done was mostly of the smuggling order, and the principal beneficiaries were English merchants. It was not until 1809, when, for political reasons, permission was given by the governor of Panama to the inhabitants of Tierra Firme to trade with Jamaica, that any renewed commercial activity became apparent.

In the meantime ideas of liberty began to stir in the minds of the Panamans, as in those of the residents of other parts of Spanish America. Mexico and Central and South America had begun that move-

ment which was ultimately to result in their independence. Nor was New Granada much behindhand. In 1810 the governor of Cartagena was arrested by the popular party and sent to Habana, and later in the year, the viceroy himself was seized in his own capital, Santa Fé de Bogotá, and sent first to Cartagena and afterwards to Spain. The juntas, which had so deftly and yet with such a high hand carried out these enterprises, next invited representatives of all the provinces of the vice-royalty to a congress for the purpose of discussing the adoption of a new form of government subject to the mother country. As yet they had not envisaged the prospect of breaking wholly with Spain. This congress, which assembled early in 1811, had no delegation from Panama, for the governor of that country refused either to take part himself or to allow other representatives from Tierra Firme to be present.

When Benito Perez, the recently appointed viceroy of New Granada, arrived in America in February, 1812, he was unable to proceed to the seat of his government at Santa Fé de Bogoát, which was then held by the revolutionists, and accordingly he established himself, with his audiencia and all the other paraphernalia of authority, first at Porto Bello and afterwards at Panama. Perez proceeded to direct operations from Panama against the insurgents, but he was signally unsuccessful, and he was ere long deposed by the home government. Francisco Montalvo, his successor, removed to Santa Marta, and thus left Tierra Firme comparatively free to work for its independence. The desire for freedom rapidly spread there, and when, late in 1813, it was proposed to establish a confederation consisting of New Granada, Quito, Venezuela, and Tierra Firme, the people of the last-mentioned country were enthusiastic in its favor. They were held in check, however, by Joaquin Carrion, the senior oidor of the audiencia of New Granada, which was left behind at Panama by Montalvo when he went to Santa Marta.

In 1815 Spain, seeing the danger of losing her hold on her American colonies, dispatched to the scene of hostilities an expedition of 15,000 men and a large fleet, well equipped with artillery and stores, under Mariscal de Campo Pablo Morillo, and soon afterward a fresh force under Alejandro de Hore was sent out to cooperate with Morillo and in particular to hold Tierra Firme. Hore was appointed governor of Panama and applied himself vigorously to the maintenance of Spanish rule throughout his province.

In December, 1818, an expedition was fitted out in England to abolish Spanish dominion on the isthmus. The moving spirits in this undertaking were Gregor MacGregor and José María del Real, and they succeeded in enlisting the sympathy and the financial support of some English merchants for their enterprise. On April 8, 1819, the invading force appeared with five ships before Porto Bello and easily captured it. José Elias Lopez and Joaquin Vargas Besgara were respectively proclaimed governor and vice-governor of Tierra Firme. Arrangements were then made for a march to Chagres and Panama, but the discipline of the newcomers was very lax, there were no funds to pay the troops, and sickness and death decimated their ranks. Hore, who was of a distinctly aggressive type, did not wait for the enemy to come to him, but carried the fight to them, and marching across the isthmus with about 500 men reached Porto Bello on April 29. Early the following morning an attack was made and Porto Bello was retaken, among those slain in the brief battle being the ill-starred newly appointed Governor Lopez. MacGregor escaped by rushing to the beach and swimming to one of his ships. After negotiation, the forts surrendered, and that was the end of MacGregor's raid.

The congress held in December, 1819, at Angostura, in Spanish Guiana, and presided over by Simon Bolivar, constituted New Granada, consisting of the modern Colombia, Venezuela, and Quito or Ecua-



1. Sally-port, Fort San Lorenzo. 2. Ruins of Cathedral, Old Panama. 3. Spanish Fort, Porto Bello.
4. Bridge on oldest highway across American Continent, Panama to Nombre de Dios.
5. Torre del Homenage, Santo Domingo. 7. Palace of Diego Colon, Santo Domingo. 6. Samaná Bay, Santo Domingo.

dor, into an independent state, to which was given the title of the Republic of Colombia. As the Isthmus of Panama or Tierra Firme at that time belonged to New Granada, it naturally formed one of the departments of this infant republic, and was itself divided into the two provinces of Panama and Veragua.

Concessions to popular sentiment now seemed to the home government to be a necessity, and accordingly a change in the administration was effected. The constitutional régime, granted in 1810, and finally adopted and promulgated in 1812 but abrogated by Fernando VII in 1814, was restored in 1820, and the people of the isthmus were for the first time allowed to exercise the right of suffrage. The ayuntamiento now established was regarded as being favorable to independence, and it is said that the changed aspect of affairs so painfully affected Hore, the sturdy champion of absolute monarchy, that it brought about his death, which occurred at this time. He was succeeded in the military command by Pedro Ruiz de Porras and in the civil governorship by Pedro Aguilar, of whom the former was friendly to constitutional government and the latter was lukewarm in defense of Spanish privileges. The cabildo was, therefore, free to demand, as it did demand, the full application of the various measures provided in the national constitution. Progress in this direction was, however, checked by the arrival of the viceroy, Samano, in Panama, with the avowed object of making the isthmus the center and seat of his government. In the carrying out of this determination he was opposed by the cabildo and by all in favor of constitutional principles, but by the aid of the military he succeeded in establishing himself at Panama. Uneasy at his presence, but nothing daunted, the city council, elected in 1821, renewed the demand for the enforcement of the constitution. Samano put them off by evasions, and a tense situation was relieved only by his death on August 3.

Samano's successor was Juan de la Cruz Mourgeon, who, however, received only the title of captain-general, with the understanding that he was to be made full viceroy when he had reconquered two-thirds of New Granada. Mourgeon also established himself on the isthmus, but completely reversed the policy of his predecessor by putting the new constitution in force. This action of his appeared to give so much satisfaction that he was deceived into the belief that the isthmus was safe for Spain, and applying himself to the task of gaining his viceregal title by making the necessary territorial gains, he got together four vessels and some infantry, cavalry, and artillery, and set sail on October 22, 1821, on what he hoped would be a career of conquest.

No sooner was his back turned than the movement for the independence of Panama proceeded apace: meetings were held, plans were made, the troops in the garrison were tampered with, and finally, on requisition from a number of citizens, there was held on November 21, 1821, an open session of the ayuntamiento, at which a resolution was adopted declaring the Isthmus of Panama independent of Spain. After discussion, in which some favored absolute independence and others union with Peru, it was finally decided that the isthmus should voluntarily annex itself to the Republic of Colombia. José de Fabrega, who assumed the title of Jefe Superior del Istmo, was entrusted with the task of organizing the new government and putting it on a permanent basis. A minute of the declaration of independence and of the various other resolutions passed was drawn up by a committee appointed for the purpose, and was signed by Fabrega, by the bishop, by twenty-five or thirty leading citizens, and by the public notary. Thus peacefully did Panama, after more than 300 years' subjection, pass forever from the dominion of Spain.

In 1829 Venezuela seceded from the republic of Colombia, and in 1830 Quito or Ecuador followed suit. In 1831 the re-

maining territory, corresponding to the modern Colombia, was organized into the republic of New Granada, of which the isthmus formed a part. In the following year a constitution was promulgated and the territory of the republic was divided into eighteen provinces, each of which was to have control of its local affairs. The provinces of the isthmus were Panama and Veragua. An attempt made in 1831 by Colonel Alzuru to detach these two provinces from New Granada ended disastrously, for a force from Bogotá defeated the rebels, and Alzuru was captured, tried by court-martial, and executed in the city of Panama. Another attempt at revolution in 1832 was easily nipped in the bud. For about nine years there was comparative quiet on the isthmus, and then, in 1840, the affairs of New Granada being chaotic, Panama and Veragua declared themselves independent under the title of the State of the Isthmus of Panama. A president and a vice-president were elected, and the machinery of government was set in motion. The new republic, however, was short-lived, for in 1841, on a threat of the use of force from Bogotá, the people of Panama peacefully submitted. For some sixteen years thereafter the relations between the isthmus and the other provinces of the republic appear to have been satisfactory.

A combined protest made in 1854 by the consuls of the United States, Great Britain, France, Portugal, Denmark, Ecuador, Brazil, and Peru to the governor of Panama set forth that passengers crossing the isthmus were not afforded proper protection, but the protest produced no official result except a denial of the neglect and a refusal by the governor to recognize the right of the consuls to make such representations to him. The facts, however, had been truly told, for the isthmus was crowded with criminals and desperadoes from every country, attracted thither by the prospect of plunder, and by them passengers were robbed, baggage was rifled, and women were insulted and outraged. In view of this deplorable situation the citizens themselves and some foreigners, with the acquiescence of the governor, organized a police force known as the Isthmus Guard, whose function it was to protect the route between Panama and Colon. At its head was placed a young Texas ranger with the peculiar name of Ran Runnels, who had authority to inflict even the death penalty on all found committing, or proved to have committed, crimes of violence. Runnels set to work quietly but determinedly, and having caught and executed some of the robbers, he so terrified the rest that they quickly left the country. When its work was done the Isthmus Guard was dissolved.

Of course the foreigners, other than bandits, who frequented the Isthmus, or passed through it, were not always impeccable, and they often gave great annoyance to the residents and provoked among them feelings of intense hostility. To this cause are to be assigned some minor riots which occurred in 1850 and 1851, and also the great riot which broke out in Panama city on April 15, 1856. The immediate origin of this disturbance was the refusal of one Jack Oliver, a drunken man, to pay for a slice of watermelon which he had taken from a fruit-stand. A fight between foreigners and residents, the latter mostly negroes, then ensued and lasted three hours, when the foreigners were obliged to take refuge in the railroad station. Here they were surrounded by an infuriated mob, who fired upon the building and hit one man. The doors were then closed and those inside were besieged. A force of troops was sent by the government, at the request of the United States consul, to quell the disturbance, but instead of dispersing the mob, they fired into the station and injured some of those who were there congregated. Finally the mob forced their way into the building, killed and wounded several persons, and stole everything they could lay hands on. The casualty list showed that of the foreigners sixteen were slain and fifteen wounded and of the residents two were killed and thirteen wounded. There was subse-

quently a long correspondence on the subject between the United States Government and the government of New Granada, and the outcome was that on September 10, 1857, a convention was agreed to between Secretary of State Cass and the minister of New Granada for a settlement of all claims, New Granada admitting its responsibility for the consequences of the riot.

One result of the whole regrettable affair was that American passengers, who were formerly wont to pass some time on the isthmus and to spend their money freely there, thenceforward hurried across the country with the least possible delay, and spent nothing, to the great detriment of the business people of Panama. Another result was that bad feeling was engendered and American citizens were frequently ill-treated, so that in February, 1859, the president of the United States found it incumbent on him to ask Congress for the necessary authority to protect Americans on the isthmus.

In 1853 the congress of New Granada made an important change in the constitution, by which the republic became a confederation, and each of its constituent parts was given the right to declare itself independent and to enter into merely federal relations with the central body. In 1855 this privilege was extended to the isthmus, which, as a member of the confederation, was made into a state consisting of the four provinces of Panama, Veragua, Chiriqui, and Azuero. Under this new dispensation the Estado or State of Panama promulgated through a constituent assembly its constitution on September 17, 1855. There was to be a legislature, and the executive of the state was to be a governor elected by popular vote. Until the time came for election to the latter office, the executive power was vested in a jefe superior provisorio.

The first election for governor took place amid stormy and exciting scenes on August 15, 1856. The votes were duly cast, but, as often happens, the real struggle was on the count. Here an extraordinary state of affairs was revealed, for the white section of the population claimed that Bartolomé Calvo, a colored man, had been elected by a substantial majority, while the negroes maintained that the choice had fallen on a white man, Manuel Diaz. So high did party and racial feeling run that many white people deemed it necessary to take refuge on a United States warsloop, the *St. Mary's*, whose commander further took the decisive action of bringing his vessel inshore and landing marines to protect the whites. The legislature finally declared that Calvo had been elected to serve for two years from October 1, 1856. His administration was wise, prudent, and moderate, and he improved the financial condition of the state and fostered education. He had made himself respected by all parties when at the end of nineteen months, on his election to the attorney-generalship of New Granada, he resigned the governorship. The term was completed by Ramon Gamboa, the first designado.

The next governor was José de Obaldia, who held office from October 1, 1858, to September 30, 1860. During his incumbency an attack made by the negroes on the whites in April, 1859, was frustrated only by the intervention of a force of military sent to restore order. On this occasion also American marines were landed, but were not called upon to use their arms. Another similar attack in September, 1860, was put down by the landing of armed blue-jackets from the British ship *Clio*.

To Obaldia succeeded Santiago de la Guardia. Guardia's administration was disturbed by the imbroglio caused by the secession, in 1860, of the States of Cauca and Bolivar from New Granada and their formation of the independent confederation of the Estados Unidos or United States of Colombia, under the dictatorship of Mosquera. With the object of keeping his own state free from the civil war then going on, Guardia, on September 6, 1861, concluded with the representative of the new nation an agreement by which Panama was to become a member of the confedera-

tion without taking any active part in the struggle. The legislature having on October 15, 1861, approved of his action, the state of Panama was formally annexed to the new republic. In order to assert its own status Panama, in July, 1862, officially took the title of Estado Soberano or sovereign state. All Guardia's efforts to keep Panama out of trouble were, however, unavailing. In July, 1862, in contravention of the terms of the agreement of the previous year, an armed body of troops under General Peregrino Santa Coloma was sent from Cartagena to Colon, and thence proceeded to the City of Panama, whereupon Guardia, yielding to *force majeure*, removed the seat of government to Santiago de Veragua. Immediately, with Coloma's connivance, a meeting consisting nearly altogether of colored men assembled at the cabildo of Panama, declared Guardia deposed, and elected Manuel Diaz as provisional governor. In a conflict between the opposing factions on August 19 Guardia was killed. Diaz continued to hold office until in the following year Panama was definitely merged in the United States of Colombia.

CHAPTER XIII

THE UNITED STATES OF COLOMBIA

United States of Colombia Established—Panama a Federal and Sovereign State—Panaman Constitution Promulgated—Goitia Provisional President—Coloma President—Colancha President—Deposition of Colancha—Presidency of Jil Colunje—Presidency of Olarte—His Death—Rise and Fall of Juan José Diaz and Ponce—Presidency of Correoso—Succession of Neira—Aizpuru Deposes Neira—Cervera Made President—Restoration of Neira—Landing of U. S. Troops in Panama—Diplomatic Correspondence—Its Result—Neira's Resignation—He is Appointed Provisional President—His Deposition—Presidency of Miro—Election and Deposition of Arosemena—Aizpuru Becomes Provisional President—His Administration—Correoso Becomes President—His Resignation—Casorla Succeeds—Aizpuru Captures Casorla—Casorla's Restoration—His Resignation—Ortega Succeeds—Presidency of Cervera—He is Impeached and Suspended—Ruiz Fills the Vacancy—Suspension of Cervera Declared Invalid—Ibañez Deposes Cervera—Restoration of Cervera—His Deposition—Ruiz Again President—Martial Law Proclaimed—Intervention of Colombia—Cervera Restored—Lambert Elected President—Prevented from Taking Office—His Address to Colombia—Cervera's Resignation—Leon Made President—Meeting of the Convention—Vila Appointed President—He Gets Leave of Absence—Arosemena Becomes Temporary President—Aizpuru's Revolt—Arosemena Resigns—Aizpuru Proclaims Himself President—Affairs at Colon—Action of Preston—His Rout—Colon Destroyed by Fire—Preston's Fate—Aizpuru Surrenders—He is Sentenced to Exile—Punishment of Correoso.

To a convention held at Rio Negro, in Antioquia, in February, 1863, Mosquera resigned his dictatorship, whereupon a provisional government was appointed, and a constitution was drawn up and ratified in May, under which the nation of the United States of Colombia came formally into being, with the Isthmus as one of its federal and sovereign states. A Panaman constituent assembly, which began its sittings on May 6, drew up a constitution of 21 titles and 112 articles in conformity with the constitution adopted by the United States of Colombia. This Panaman instrument was promulgated on July 6. The president of the constituent assembly, Pedro Goitia, was appointed provisional president of the State to hold office until October 1, on which date the president elected by the voters of Panama was to take up the reins of government. Goitia, however, did not fill even his short term, for he was forced to resign, and Peregrino Santa Coloma was chosen by the legislative assembly in his room, and was afterwards declared to have been, by vote of the people, duly elected to the presidency. Coloma's tenure of office was also short, for it was terminated on his being chosen as a representative in congress at Bogotá. He was succeeded by the vice-president, José Leonardo Colancha, who was deposed by a military cabal on March 9, 1865. Colancha made a fight for his rights, but he was defeated in two battles and taken prisoner in the second.

The man who was brought to the front by this military *coup d'état* was Jil Colunje,

a colored man, and he acted as president *de facto* until a convention, which met on July 1, confirmed all his acts and appointed him president until September 30, 1866. Two small uprisings against his authority, at Panama and David, respectively, were without difficulty put down. His successor was Vicente Olarte Galindo, who had defeated Colancha's troops in the previous year. Olarte soon found himself at loggerheads with the legislature, but he overawed it by military force and drove it to submission. Although Olarte was liberal in his views and tried to establish peace and good feeling among the various classes, he failed to find favor with the negroes, who made several ineffectual attempts to break his power. Under circumstances strongly indicative of foul play he died at Panama March 3, 1868. The first designado not being on the spot, the second, Juan José Diaz, stepped into the vacant place, but his administration was of short duration, for a revolution, engineered by the negroes under General Fernando Ponce, succeeded on July 5 in bringing about the downfall of Diaz. Ponce was then made provisional president, but another revolution on August 29 forced his resignation.

Buenaventura Correoso, the first designado, succeeded. He, in turn, had soon to deal with another revolt, which, after a sharp engagement on November 12 at the Hatillo, near Santiago, he was successful in quelling. A constituent assembly, summoned by himself, then elected Correoso president for a four years' term ending September 30, 1873. He resigned, however, on October 1, 1872, and Gabriel Neira, who had been a partisan of Colancha's, succeeded, as was thought, for the remainder of the term. But Neira was the victim of another revolution headed by Rafael Aizpuru, the fourth designado and commander of the state troops, who marched into the city on April 5, 1873, and took Neira prisoner. The superior court thereupon called Damaso Cervera, the fifth designado, to the supposedly vacant presidency. The contest, however, was not yet over. A battalion of the national troops took up the cause of Neira, and, after some fighting and some negotiations, it was finally arranged that Neira should be reinstated, and he resumed his office in May. In September there was another rising under Correoso, but it was unsuccessful.

During both those disturbances it was found necessary to land troops from United States ships of war to protect the railroad transit across the isthmus. Later in the year official representations on behalf of the United States were made, embodying a protest of the Panama Railroad Company against the interference with traffic of which the disturbances were, or were likely to be, the cause, and demanding that the Colombian government should take the transit under its own direct protection, so as to safeguard it from the violence of local factions. The result was that the Colombian secretary for foreign affairs gave the required guarantee.

When the constituent assembly met on October 1, Neira tendered his resignation, which was accepted, but he was immediately appointed provisional president. At the same time the term for the president to hold office was reduced to two years. In November a new constitution of 7 titles and 144 articles was adopted. Two days later Neira started a revolution to get rid of the assembly, but, failing in his attempt, he was deposed by that body, and Gregorio Miro, the first designado, was appointed president for the term ending September 30, 1875. There were many conspiracies against Miro, the most serious of which was headed by Rafael Aizpuru, who attempted to set up a provisional government in opposition to that of the president. Miro had recourse to arms, but he had not succeeded in putting down the revolt before the expiration of his term of office.

The next elected president was Pablo Arosemena, who maintained his position for only twelve days—from October 1 to October 12, 1875—when he was deposed by the

federal troops under General Serjio Camargo, who placed Aizpuru in control as "jefe provisional del poder ejecutivo" and afterward as provisional president. In November the constituent assembly ratified Aizpuru's acts, and sanctioned his retention of the presidency until the due choice of his successor. On December 6 another new constitution of 126 articles was adopted, and on the same day Aizpuru was elected president and immediately entered on his duties. A year later a law was enacted changing the date for the inception of the presidential office from October 1 to January 1, and fixing the duration of its tenure at two years. During Aizpuru's administration the republic of the United States of Colombia was disturbed by a civil war, and, in compliance with a requisition from Bogotá, the State of Panama sent both the Colombian battalion and troops of its own to coöperate with the national government in restoring order.

Under the new regulations as to date, Aizpuru was succeeded, on January 1, 1878, by Buenaventura Correoso, but, worn out by oft-recurring disturbances, Correoso resigned in the following December, and the designado, José Ricardo Casorla, became president. Casorla had to contend against two revolts. The first was a military uprising, which was put down only after sharp fighting and much bloodshed. The second was caused by Aizpuru. Aizpuru had been elected to the congress at Bogotá as a senator from Panama, but leaving the national capital he proceeded to Colon on June 7, 1879, and declared himself provisional executive chief. At the same time, by preconcerted arrangement, Casorla was kidnapped at Panama and taken to Colon, where he was detained in durance by Aizpuru. After some indecisive fighting between the opposing factions, an arrangement was finally come to whereby Casorla was released and restored to his office, which, however, after three days he resigned in favor of the second designado, Jerardo Ortega. Ortega finished the remainder of the term.

On January 1, 1880, Damaso Cervera, the president-elect, entered on his office, and, though the butt of many an intrigue, succeeded in keeping order and completing his term. His successor should have been Rafael Nuñez, who had been declared elected, but, as the latter did not put in an appearance on January 1, 1882, Cervera, as first designado, was continued in power as acting president by successive votes during 1882, 1883, and 1884. In July of the year last mentioned he was impeached and suspended by a justice of the superior court, but appealed to General Wenceslao Ibañez, who was in command of the Colombian troops stationed in Panama, to maintain him in his position. When Cervera was suspended General Benjamin Ruiz, the second designado, was given control, but within four days a majority of the superior court decided that the decree of suspension of Cervera was invalid, and that Ruiz was therefore not entitled to the presidential office. Despite this decision, Ibañez within two days more forced Cervera out, whereupon Ruiz again took the presidency and was recognized by the Colombian executive. But at this juncture there arrived in Panama General Eloi Porto, whose rank in the Colombian army was higher than that of Ibañez, and through Porto's intervention Cervera was once more restored. Disturbances then took place in different parts of the Isthmus, and Cervera was deposed in September and Ruiz again made president. Cervera retaliated by proclaiming martial law. Between the warring factions there took place a sea conflict, in which Cervera and his forces were repulsed. The rebels having then carried the struggle into the provinces of the interior, the Colombian government commissioned the commander of its forces in the Isthmus to restore order and arrest those who were disturbing it. To strengthen his hands they directed an armed ship to proceed to Panama and sent General Santodomingo Vila to coöperate with him, In discharge of his instructions General Gonima, the officer in question, marched

to Aguadulce, where he induced Ruiz and his supporters to abandon hostilities and to recognize the government of Cervera.

For the term beginning October 31, 1884, Juan Manuel Lambert was elected president by an overwhelming majority in July, and was ratified by the assembly when it met on October 1, but by his opponents' intrigues, which General Gonima fostered and encouraged, he was prevented from assuming the duties of his office. Cervera tendered to the assembly his resignation on October 1 and again on October 20, but it was not accepted on either occasion, and on October 21 he was by almost unanimous vote requested to remain in power. On November 12 Lambert presented to the people of Colombia an address, in which he registered an emphatic protest against the unwarrantable interference of the federal government in the internal affairs of the sovereign State of Panama, by which his election by his fellow-citizens to the presidency had been rendered of no effect. At the same time he patriotically indicated that, in order to cause no complications or disturbance, he did not intend to emerge from private life. Cervera, on his part, tendered his resignation on November 25 to the superior court—for the assembly had adjourned on the 13th—stating that he had now held office for nearly five years, and that he was prepared neither to submit to nor oppose the interference of the federal government. Under those circumstances the resignation was accepted, and Vives Leon, as second designado, was summoned to the presidency, which he held until January 6, 1885.

In the meantime a convention, elected by direct popular vote in pursuance of a law passed by the assembly in the previous October, had met on January 1, 1885, and on January 6, it appointed General Ramon Santodomingo Vila president of the state, and he took office on the following day. Already on January 3 Benjamin Ruiz and his liberal followers had seceded from the convention, which, as they alleged, was improperly constituted. Owing to prevailing disturbances the president proclaimed martial law on February 9, and the convention brought its session to an end on the 11th. Six days later Vila went on leave of absence to Cartagena, where, as he truly enough represented, his presence as a military officer was required on account of a rebellion in Colombia, and Pablo Arosemena, as first designado, was inducted temporarily into the executive office. About a month later, on March 16, Aizpuru and some 250 men attacked and overran the city of Panama with much bloodshed and loss of life and great destruction of property. To protect the railroad transit, marines and sailors from the British battleship *Heroine* were thereupon landed. Arosemena summoned troops from Colon, and, arriving the next day under General Gonima, they drove the rebels out of Panama. The latter, however, did not retreat far and pitched an encampment at Tarfau. Arosemena, having received notification on March 24 that Aizpuru intended again to attack Panama, placed his resignation in the hands of the superior court and took refuge on the *Heroine*. As he had been the only designado named by the convention, there was no one legally entitled to take his place, and accordingly the federal general, Gonima, assumed to himself the whole direction of affairs, civil as well as military. Aizpuru, true to his word, delivered his attack on the 31st, and as Gonima had but a few soldiers, he surrendered after some street fighting, in which about twenty-five persons were killed and much damage was done to property. Aizpuru, by proclamation made on April 1, took on himself supreme civil and military power, to which he said he had been summoned by the advocates of freedom. By his request United States marines were landed on April 8 from the frigate *Shenandoah* to guard the transit.

In the meantime there had been hot work at Colon. Scarcely had the troops, in response to Arosemena's request, left that town for Panama, on March 16, when Pedro Preston, a mulatto from Cartagena,

placed himself at the head of a gang of desperadoes and marauders, took possession of the place, raided the establishments of several merchants, and levied a number of forced loans. On March 29 an American mail ship with a quantity of arms on board arrived at Colon from New York, but by direction of the government refused to deliver arms to the insurrectionists. Preston thereupon arrested the American Consul, two officials of the steamship company, and a lieutenant and cadet of the United States warship *Galena*. He also took possession of the mail ship and made a search for the arms, but failed to find them. His next proceeding was to send the cadet to the commander of the *Galena* with a message that he would hold his prisoners until the arms were given over to him, and that, if the *Galena* made any move to land men, not only would the boats be fired on, but also every American in Colon would be killed. The commander's activity was thus temporarily paralyzed. On a threat from Preston that, unless the arms were delivered, the four remaining American prisoners would be shot out of hand, the arms were, by direction of the American consul, surrendered, and the prisoners were released. Commander Kane of the *Galena*, however, recaptured the mail ship and sent a force of men and a few pieces of artillery ashore to secure the persons of the two officials of the steamship company, who had been again arrested and imprisoned. Just then, there arrived from Panama a detachment of Colombian national troops, who immediately engaged the rebels, and, after several hours' fighting, finally routed them. Before fleeing Preston and his men set fire to the town at different points and, as there was a strong wind, the flames spread rapidly, and nearly the whole of Colon and its contents were destroyed. The only buildings left standing were the offices of the railway, of the Pacific Mail Company, and of the Canal Company. Ten thousand persons were rendered homeless, eighteen lives were lost, and damage was done to the extent of £6,000,000. Preston was afterward captured, brought back to Colon, tried by court-martial, and hanged on August 18. Two of his principal accomplices had already suffered the death penalty on May 6. The cavalier treatment of the federal commander, Gonima, by Aizpuru so thoroughly incensed the federal government, that from Buenaventura they sent a force of 850 men under General Rafael Reyes to drive out the rebel leader and to place M. Montoya in civil and military control of Panama, until a government could be constitutionally set up. Through the friendly intervention of the foreign consuls a conflict was avoided, and an arrangement was made whereby Aizpuru covenanted to dismiss his troops, give up his arms, and abandon his political career. It was alleged, whether truly or falsely does not appear, that by May 2 he had not handed over all the rifles of his men, and on that charge he was arrested. He was removed first to Buenaventura and subsequently to Bogotá, where, on conviction by court-martial in November, he was condemned to ten years' exile with loss of civil rights and a heavy fine. Correoso, who had been commander of the state forces under Aizpuru's régime, was deprived of his new military rank.

CHAPTER XIV

THE PANAMA RAILROAD

Trans-Isthmian Communication—Various Surveys for a Railroad—Treaty of 1846—Oregon Boundary Defined—United States Acquires California—Inaccessibility of the New Territories—Steamship Lines Established—New Granada Grants Concession for Panama Railroad—The Building of the Road—Its Difficulties—Construction of Docks in Limon Bay—Passengers Carried to Gatun—Consequent Improved Condition of the Railroad Company—Foundation of Colon—Work Begun at Panama—The Bridge at Barbacoas—The Railroad Completed—Its Great Earnings—The Extended Concession: Its Terms—Decline of the Panama Railroad—Its Purchase by the Compagnie Universelle—Its Transfer to the New Panama Canal Company—Its Acquisition by the United States.

COMMUNICATION across the Isthmus was, as we have seen, established at a very early date in the settlement of the province. The paved roadway from Panama to Nombre de Dios, and afterwards from Panama to Porto Bello, which came to be known as the Camino Real or King's Highway, supplemented as it was by river transportation from Cruces to the Atlantic, served its purpose for more than three centuries, and over this route passed the treasure trains and the merchandise which for so long made the isthmian cities, and especially Panama, such important centers of commerce and trade. But there arrived a time when a cheaper and more rapid mode of transit and one suited to handle a larger traffic became necessary, and then a railroad was built from sea to sea.

However, before this consummation was finally attained, there was much preliminary work to be done and there were many attempts and many disappointments. A survey under the auspices of President Bolivar of Colombia was made from 1827 to 1829 by J. A. Lloyd, a British engineer, and Captain Falmarc, a Swede, and a report was submitted by them showing that a railroad from Chagres to Panama was practicable; but circumstances at the time prevented the inception of such an undertaking. In 1836, in pursuance of a resolution introduced in the United States Senate by Henry Clay, asking the executive to negotiate both with the states of Central America and with New Granada for the drawing up of treaties to protect United States citizens who should try to establish connection between the two seas, President Jackson commissioned Charles Biddle to go to the Isthmus, survey the ground, and report on the different routes which had been proposed for interoceanic communication. Biddle, being greatly impressed with what he saw of the Panama route, did not carry out the whole of his instructions, but instead proceeded to Bogotá, where he succeeded in securing a franchise for a trans-Isthmian railroad. This project might have materialized, but it was propounded at an inopportune moment, for the panic of 1837 prevented it from being properly financed, and just then nothing further was, or could be, done. In the following year (1838) a French company was given a concession for the construction of highways, railroads, or a canal across the isthmus. Napoleon Garella, an engineer sent out by the French government to study and report on the whole situation, recommended a canal from Limon Bay to the bay of Boca del Monte, twelve miles west of Panama; but want of capital caused this canal project, as well as

the other projects envisaged by the concession, to be abandoned. W. B. Liot of the British Navy proposed in 1845 the construction either of a macadamized highway or of a railroad from Porto Bello to Panama. It remained, however, for United States citizens to build the railroad, as it afterwards remained for the United States government to complete the canal, across the Isthmus.

A treaty made between the United States and New Granada on December 12, 1846, guaranteed to the first named of the high contracting parties the right of way across the Isthmus of Panama upon any modes of communication that then existed or that might afterwards be constructed. The boundary dispute concerning Oregon had been definitely settled in the same year, and in 1848 Mexico ceded by treaty the whole of Upper California to the United States. All this new territory awaiting settlement and development attracted universal attention, and the nomadic population of the eastern states began to turn their eyes westward. There were at first but two ways of reaching the Pacific Coast. One was by ship around Cape Horn, a distance of some 12,000 miles, and the other by a journey of 3,000 miles in prairie schooners or other pioneer contrivances from the Missouri River across the plains. Either way was fraught with grave danger and required months for the passage. At sea tremendous storms were encountered both in the Atlantic and especially in the miscalled Pacific, and the transcontinental route lay through a vast stretch of desert, and soon every mile of the way from the Missouri to the Sacramento was marked by the bleaching bones of unfortunate emigrants. Under such circumstances Oregon and California were well nigh inaccessible to the desired class of settlers, and the administration of the laws was surrounded by a thousand difficulties owing to the great distance from the seat of authority and the slowness of communication.

It was therefore under such circumstances natural for the United States government to turn its attention to finding a safer, shorter, and less expensive route, for it was to its interest that its Pacific possessions should be peopled by its own citizens. Accordingly in 1848 Congress, after long and anxious consideration of the whole subject, authorized the running of two lines of mail steamships, one from New York to Chagres, and the other from Oregon and California to Panama, the connection between them to be made by transit across the Isthmus as already secured by the treaty of 1846. An essential part of the transaction was the appropriation of money to pay for the carriage of the United States mails by those ships. Responsible bidders for the contracts were long waited for in vain. At length two men of great wealth and judgment, George Law and William H. Aspinwall, came forward and took, the former the Atlantic, and the latter the Pacific, contract, and soon the steamers began to ply on both sides of the North American continent. In the Atlantic contract there was a prospect of gain with comparatively small risk, as the line connected with Savannah and New Orleans as well as with Chagres; but, at a time when gold had not yet been discovered in California, men wondered greatly why Aspinwall should take the risk of running a line of steamships from Panama to San Francisco and thence to Oregon. But it soon developed that for his future profit he was not looking to the mail boats alone, and that they were indeed only secondary to the vast project he had in mind.

Up to this time, as we have seen, nothing had been done to alter the old mode of transit across the Isthmus, which was effected partly by dugouts poled and paddled up the Chagres River to Cruces and thence by the old paved road, now much the worse for wear, to the city of Panama. The road was so rough that even sure-footed mules could travel it only with great difficulty, and four or five days were usually required for the journey. To remedy such conditions, and at the same time to make a huge profit, Aspinwall had conceived the

bold idea of building a railroad, which would not only cut the travel-time from the Atlantic to the Pacific from four days to four hours, but would thereby also shorten the distance from the Atlantic ports of North America to those on the Pacific, as well as to Australia, China, and the western ports of South America, by several thousand miles. Accordingly, Aspinwall with Henry Chauncey, a New York capitalist, and John L. Stephens, who had traveled and explored extensively in Central America, entered into a contract with the government of New Granada and secured from it the exclusive right for the construction of such a road. The contract stipulated that the railroad should be built within eight years, that it should transport passengers, live-stock, and merchandise on a fixed scale of rates, that all public lands lying along the line of the road were to be used gratuitously by the grantees, that the termini of the road on the Atlantic and the Pacific sides were to be free ports, that New Granada should receive three per cent. of the net profits, and that the concession should be in force for forty-nine years from the completion of the work, with this reservation, however, that, after twenty years, the government of New Granada was to have a right to purchase the railroad for $5,000,000.

The Panama Railroad Company was thereupon incorporated with a charter obtained from the legislature of the State of New York. The capital was fixed at $1,000,000, and the stock was quickly taken up, for, between the obtaining of the concession from New Granada and the charter from New York, a circumstance had occurred which changed the whole aspect of affairs, and led capitalists to believe that there would be a speedy and highly lucrative return on their investments. This auspicious occurrence was the discovery of gold in California in the latter part of 1848, which at once created a mad rush of emigrants through the Isthmus to the supposed El Dorado of the West.

The construction of the road was at first let to two contractors, Colonel George M. Totten and John C. Trautwine, but that very circumstance which argued so well for the future success of the railroad when built was the cause of delay in starting to build it. The contractors on arriving at the Isthmus found that the "gold-rush" had made labor so scarce and dear, and the procuring of materials so uncertain and costly, that it would ruin them to go on with the work. They asked, therefore, to be released from their contract and, their request being complied with, the company itself undertook the building of the road, retaining its former contractors as engineers. A survey, carried out under the direction of J. L. Baldwin and Colonel George W. Hughes of the United States Topographical Corps, discovered a new summit gap, and found it practicable in consequence greatly to lessen the grades and shorten the line. The Atlantic terminus was located at Limon Bay and the Pacific terminus at Panama City, the distance between the two points being some fifty miles.

In May, 1850, the first sod was turned on Manzanillo Island in Limon Bay. It was only a short line, but the difficulties surrounding its construction were enormous. The situation was near enough to the equator to make a sultry tropical heat prevail at all seasons. For nearly half the year the country was deluged with rain, so that the working gangs, in addition to being drenched from the clouds, were obliged to wade in mud and water from two to four feet deep. For the first few miles out from the Atlantic terminal the route lay through a deep morass covered with a dense jungle, reeking with malaria, and abounding in noxious reptiles and insects. Thence the greater part of the line was through a rugged country where chasms, turbulent rivers, and mountain torrents had to be crossed. Materials of all sorts as well as laboring men had to be brought from long distances. The workers were constantly attacked with fever and malaria, and, though the whole work-

ing party was changed every week, it was necessary to keep constantly importing others to take the places of those who fell sick or died. For this purpose agents were kept in Jamaica and elsewhere to engage men, particularly negroes, who of all races seemed best suited to requirements; but, despite every effort and the almost daily arrival of vessels bringing fresh laborers, there were times when owing to universal sickness the work was almost at a standstill. Dogged perseverance, however, succeeded in laying the rails and running work-trains as far as Gatun, seven miles out, by October 1, 1851. Meanwhile docks were being constructed in Limon Bay for the convenience of vessels tying up there.

These two factors soon gave rise to a new development. In November, 1851, two steamships, crowded with men bound for California, arrived in the open roadstead of Chagres. These passengers expected to cross the Isthmus viâ the Chagres River and the old paved road, but the weather was so tempestuous that several lives were lost in an effort to effect a landing by crossing the bar of the river, and the ships were forced to take refuge in Limon Bay. It was then suggested that the passengers, eager to be on their journey, should not wait for more settled weather to return to Chagres, but should be conveyed over the new railroad to Gatun, from which point they would be transported up the river in native boats as usual. At the time there was not a single passenger car on the line, nor could one be had nearer than Philadelphia; but the managers of the road decided to attempt the transfer on flat-cars or work-cars, and more than a thousand emigrants, glad of any method, however primitive, of avoiding delay, were disembarked and safely transported to Gatun, where they began their river journey. This fortuitous circumstance probably saved the whole railroad project from disastrous failure. The company's stock had fallen very low, for the original million dollars of capital had been spent and the road was far indeed from completion. The directors had in fact been carrying the burden for some time, and were keeping the work moving at enormous expense on their own individual credit; but now, keen business men as they were, they saw open to them a source of immediate revenue, which would give new life to the company, and they determined to work it for all it was worth. In conformity with this resolution they at once ordered passenger cars, and began the regular carriage of emigrants and others to Gatun, and to more distant points as the rails were laid. When one of the steamers, whose passengers had been transported by rail to Gatun, returned to New York carrying the news that gold-seekers and intending settlers en route for California had been landed at Limon Bay instead of at Chagres, the friends of the enterprise took heart afresh, the value of the stock quickly advanced, and it was no longer difficult to attract the sorely needed new capital. Thenceforward the mail steamers abandoned Chagres and plied regularly to Limon Bay, and the wisdom of the early building of docks for their accommodation was made manifest.

As the island was cleared a settlement had gradually grown up around the Atlantic terminal. On February 2, 1852, this settlement was formally inaugurated as a city, and named Aspinwall in honor of the originator of the road. This designation was never recognized by the authorities of New Granada, who took up the position that the place should be called Colon, the Spanish form for Columbus, the discoverer of Limon Bay. The two names persisted side by side for years, but the question was finally decided in favor of Colon, because the New Granada government refused to deliver mail addressed to Aspinwall. Thus Colon it became, and Colon it still remains.

The number of laborers was now largely increased, and every incoming steamer brought more hands, so that the work was pushed forward with renewed energy and zeal. By March, 1852, regular passenger trains were running to a station sixteen miles out from the terminus, and by July

to Barbacoas, twenty-three miles out. Men and material were also shipped around Cape Horn, and work was begun at the Panama end.

At Barbacoas a great bridge had to be constructed over the Chagres, a river at that point about 300 feet wide, running through a deep and rocky channel, and subject to a rise of forty feet of water in a single night. About this time the first president of the railroad company, John L. Stephens, died, and his successor let the building of the bridge and of the remainder of the line by contract. The bridge was nearly completed when a sudden flood swept it away. After a whole year had been wasted and the contractors were on the verge of bankruptcy, the company released them, and, under a third president, set out itself to complete, as it had begun, the work. Laborers had again become scarce, and again operations had to be temporarily suspended for want of them. Agents were then sent in haste to Hindostan, to China, to Ireland, and to all the countries of continental Europe, and a force of several thousand men was gathered together and taken to the Isthmus. Of these a thousand were Chinese coolies, of whom great things were expected, but some few of their number having died of fever, the rest were seized with nostalgic melancholia and developed a suicidal mania, and scores of them took their own lives. In the end scarcely 200 Chinese left the Isthmus alive. The other workers also fell victims to sickness, and many of them had to be reshipped to the points whence they came. Despite all difficulties, however, a massive timber bridge was eventually thrown successfully across the river at Barbacoas.

By January, 1855, the crest of the divide at Culebra, a distance of thirty-seven miles from Colon, was reached. Here the workers rested, and awaited the coming of their collaborators from Panama, who were pushing their eleven-mile section up the valley of the Rio Grande. On that side the engineering difficulties had not been so great, the route did not lie through swamps, and the workmen were less liable to fatal sicknesses. At midnight on January 27, 1855, in the midst of a torrent of rain, the last rail was laid, and the two ends of the road were connected. The next day a locomotive passed from sea to sea. It was a great engineering triumph and a great testimony to the push, energy, and faith of its originators. The summit grade was 258 feet above the sea-level. The entire length of the road was forty-seven and three-quarter miles, and it had required the construction of 170 bridges and culverts, one of the bridges being more than 600 feet in length.

Although the railroad was open, the company's work was by no means completed. For the great traffic expected, preparations had to be made, including additional tracks at each terminus, needed side-tracks at different points, and passenger and freight depots. Owing to the haste to get the road constructed through to Panama, much of the work had been temporary in character, especially bridges, culverts, and trestles. The trestles were converted into solid embankments; the wooden bridges were replaced with iron; the ties of native wood, which were already rapidly decaying, were removed and replaced with ties of lignum-vitae brought from Cartagena. This wood was so hard that it had to be bored before the spikes could be driven in, and so durable that, when taken up in 1910, because of the relocation of the line, the ties were found to be still unrotted. In addition to all this work, both of the new and the replacement order, additional engines and cars had to be provided.

To gain breathing space by checking traffic until the company was prepared to handle it in full volume, the superintendent recommended the charging of a prohibitive rate. He suggested $25 for the one-way journey for passengers between Colon and Panama, and more than fifty cents a mile per cubic foot for freight. These rates were actually adopted, and remained in force for more than twenty years, but they did not keep away traffic, and thus the Panama

Railroad Company became one of the greatest dividend-earners in the world, the stockholders receiving at one time as much as twenty-four per cent. per annum on their investment. The construction accounts were closed in January, 1859, and showed that, instead of $1,000,000, it had in reality cost $8,000,000 to build this railroad of less than fifty miles. But it had already earned $2,000,000 before the communication was open from sea to sea in 1855; by 1859 it had earned more than half enough to pay the entire cost of construction; and by January, 1865, its total profits were $11,340,000. These figures will not be so surprising when we remember that the rates were exceptionally high, and that the company had a monopoly of the Atlantic trade of the entire west coast of North, Central, and South America. It was a frequent occurrence to transport over the line in a single half day 1,500 passengers, all the United States mail, and the freight of three steamships.

The railroad was thus beyond question a source of wonderful profit to its fortunate owners; but the government of New Granada had by contract the right to purchase, in 1875, for $5,000,000, this property which it had cost $8,000,000 to establish, and which was paying twenty-four per cent. dividend on that amount. Some new arrangement was manifestly necessary. Accordingly in 1867 Colonel Totten went to Bogotá, and, in consideration of $1,000,000 in gold, cash down, of $250,000 a year, of promising to carry the New Granadan mails free, and of guaranteeing to extend the road to certain islands in the Bay of Panama, he obtained for the company a new franchise for ninety-nine years with additional large grants of public lands.

In 1869, on the completion of the Union Pacific Railroad, the Panama Railroad lost its Californian trade, but still retained its trade with South and Central America, which was borne to it almost exclusively by the ships of the Pacific Steam Navigation Company. This haulage, too, the railroad subsequently lost when, in consequence of a dispute, the Navigation Company was obliged to give up its shops and dockyards on the Island of Taboga, in the Bay of Panama, and send its ships by way of the straits of Magellan direct to England. The affairs of the railroad were for some years thereafter in a languishing condition and its stock was greatly depressed, until in 1879 it sold out both its stock and its rights to the Compagnie Universelle du Canal Interocéanique for $18,000,000. The railroad passed with the other assets of the Compagnie Universelle to the New Panama Canal Company in 1894, and from it to the United States in 1904, the valuation set upon it in the latter transaction being $7,000,000, the par value of outstanding stock. Since then the railroad, re-located and modernized at an expense of $9,000,000, has been profitably worked by the United States government.

Today the United States owns at Panama one of the finest railroads in the tropical world. It parallels the canal, and connects the principal cities of the Republic of Panama. It is a modern, single tracked, five-foot-gauge road, built on high ground in a low country. It has embankments as high as 78 feet, which settled from twenty-five to sixty feet on the soft subsoil.

At places the engineers had to make the foundations of the embankments twice as wide as engineering practice demands, because of the immense weight of the fills. There are 167 embankments in the forty-seven-mile road, and 160 cuts. One of the embankments is three miles long. The whole road required about 16,000,000 cubic yards of material for filling, or enough to make one fill all the way across the isthmus 9 feet high and 12 feet wide. The reconstruction cost the United States nearly $9,000,000, or approximately $170,000 a mile.

And yet, the road earned its way in returns, to say nothing of the powerful support it gave to the work of digging the Panama Canal. During the years between the acquisition of the road and the completion of the canal, it brought into the

coffers of the United States a net revenue of upward of $15,000,000—enough to pay for the old road and to build a new one.

When the United States bought the road it was worse even than the proverbial two streaks of rust and a right of way. The rails were the old fashioned hollowed out Belgian type, and the rolling stock was a nightmare of rust and ruin to the practiced railroad man. Built at a time when circumstances demanded that it follow the lines of least resistance, it was a road that led through marshes and over hills with little attention to grading.

When the United States took over the road and the Canal Zone there was an attempt made to maintain the canal work and the operation of the railroad as separate and distinct enterprises, with the railroad lending what aid it could to the work of building the canal. But it was soon found that this was unwise, as it gave rise to conflict between the railroad management and the canal commission. It took a long time and the unwinding of much red tape to get matters through; and if there was not friction between the two enterprises, there at least was a lack of the spirit of "all things subsidiary to the building of the canal."

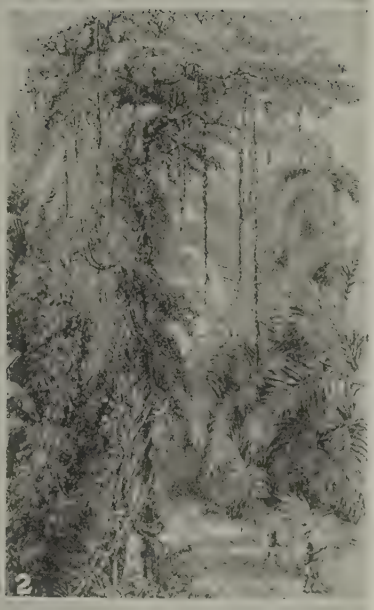
How to overcome the trouble and still to preserve the separate corporate existence of the Panama Railroad Company was a problem. Separation was necessary because of the terms of the concessions under which the railroad was operated, and because, also, of the fact that a railroad could not very well be operated under a law which required all of its passenger and freight receipts to be turned into the federal treasury instead of into its own treasury. At last the plan was hit upon of making the chairman and chief engineer of the canal president of the railroad, and the members of the commission its directors. This arrangement worked admirably, since it complied with all the terms of the concession, retained for the railroad the advantages of a separate corporate existence, and yet made it as much a part of the canal construction organization as though it had no trace of a separate existence.

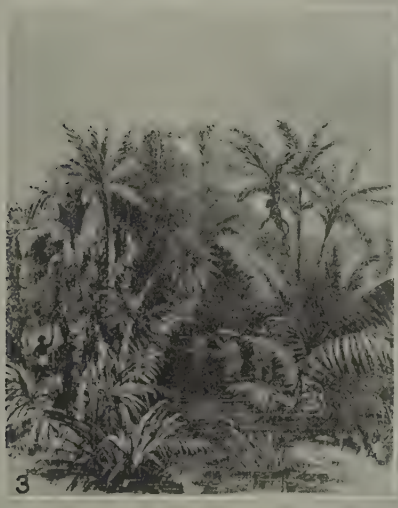
The situation of the Panama Railroad was an anomalous one. Here was a transcontinental line owned by the United States Government, operating under a concession of the Republic of Colombia, connecting the principal cities of the Republic of Panama, and doing business under a charter of the State of New York. Still further to add to the peculiarities of the situation, the government of Colombia claimed that when the concession of the railroad should expire its property would revert to Colombia. If that were so, then, since the railroad owned the land on which the city of Colon is built, Columbia would reacquire the property rights of one of the cities that had thrown off the yoke of her dominion.

As matters stand today the United States owns the railroad and will continue to operate it. Its operation will be more fully a part of the canal organization than heretofore. The treaty with the Republic of Panama gives to the United States the right to take over the road and expressly provides that whenever the concession ceases from any cause the United States is to enjoy all the rights that Colombia would have enjoyed had Panama not revolted. Under this treaty the United States will be the fee simple owner of the Panama Railroad when its concession ceases. This will be ninety-nine years from the time the road was opened.

As noted, the operation of the railroad during the period of the construction of the canal was very profitable. During that period it carried some twenty million passengers and many millions of tons of freight, with a new operating revenue of some fifteen million dollars. In a single year it carried three million passengers and over a million tons of freight. In addition to this it handled over its tracks about 40,000,000 tons of spoil a year, which served to make it the busiest line of railroad in the world. Although the road was only forty-seven miles long it had several hun-











From Otis's "History of the Panama Railroad," 1861.

BUILDING THE PANAMA RAILROAD

1. First train leaving Colon for Panama.
2. "Stephens's tree."
3. Surveying in the jungle.
4. The first shanty.
5. Col. George M. Totten, Chief Engineer.

dred miles of switch and other tracks to accommodate the vast amount of business handled over it.

The rates on the Panama Railroad fixed by the canal authorities were high in comparison with those in the United States, first class fares being at the rate of five cents a mile. But the service was the best to be found in any part of the tropical world. Second class fares were one-half the first class fares, and the second class passengers nearly trebled the first class passengers. Especially was this true after each canal pay day. The negro employees on the isthmus hugely enjoyed riding on the railroad trains, and they, with their families, added greatly to the traffic.

The difference between first and second class rates was sufficient to accomplish a separation of the races in travelling through the canal zone.

In addition to operating the railroad, the Panama Railroad Company operated a line of steamships from New York to Cristobal. This steamship line was a constant drain upon the finances of the railroad company, and was not able, during the whole time of its operation by the government, to make itself self sustaining. But at the same time it afforded so many advantages in the prompt handling of freight, mail, and canal supplies that it was not thought wise to discontinue the service during the construction of the canal. The steamship line made weekly sailings from New York and from Panama. Some years its operation would show a deficit of more than a quarter million dollars, thus emphasizing the inability of American ships to compete with those of other countries under our American high-wage standards. While the Panama Railroad Steamship Line was operating at a loss in a direct service, the United Fruit Line, with a large number of sailings from New York and New Orleans, with numerour ports of call, was operating at a fine profit.

When the matter of a permanent policy by the government towards the Panama Railroad came up, Chief Engineer Goethals recommended that the government go out of the steamship business, except for the carrying of its own supplies. He advised further that arrangements be made to sell the steamships on hand, and to substitute for them specially built coal carrying steamers, with which the United States could carry its coal from Newport News and Norfolk to the isthmus.

A question of operation which still remains to be settled is whether the Panama Railroad shall continue to be operated by steam or whether it shall be electrified. Sufficient water power is developed at Gatun Dam during ordinary seasons to furnish all of the power necessary for the operation of the canal machinery and for the Panama Railroad in addition. But it has not been decided whether sufficient power would be generated in dry seasons to run both the lock machinery and the railroad. However, since there is an auxiliary steam plant at Miraflores, where fuel oil from the California fields can be had at a low rate, it is probable that this power could be used to supply any lack of current that low water might cause. It is not improbable that the course ultimately decided upon will be to keep the present equipment of the Panama Railroad in commission so long as it lasts, and then to change over to electricity as the regular motive power of the railroad.

As soon as the United States took over the canal property plans were laid for improving the railroad. Chief Engineer Wallace wanted to make a three or four track road across the isthmus, but it was finally decided to develop the road just as the work of constructing the canal went forward. Under this plan of development the old Belgian rails were replaced by the best ninety pound steel rails, while a double tracked road with curves straightened and grades lowered was substituted for the old line. The rolling stock was changed and brought up to the best American standard, and with the engines and cars bearing the letters "P. R. R." one

might have thought himself in a region where there was a tropical edition of the Pennsylvania Railroad. It was necessary many times to change the location of parts of the road. When the Gatun Dam and Spillway reached the elevation that permitted the water to be impounded in the Chagres Valley, more than half of the original Panama Railroad right of way was put under water. But by that time the work of building the New Panama Railroad had reached such a stage as to make possible the abandonment of the old road across the bottom of what is now Gatun Lake. The new road now skirts the east bank of the lake, here and there crossing an arm of that great body of water. Whereas the old road crossed the canal a number of times, the new one keeps to the left of the big waterway the entire distance from Colon to Panama. The first section of the new road to be opened was the part from Gatun to Gamboa. At the latter place trains were switched across the canal over the crest of the Gamboa dike. From this point to Pedro Miguel the old line was used until the latter part of 1913, because all the principal towns were on that side of the canal. From this point to Paraiso the new line was used. Here the canal was crossed on a trestle and the run made into Panama over the re-location. When the time came to blow up Gamboa dike the entire new line was thrown open, and all that was left of the old Panama Railroad was the name and a shuttle service from Pedro Miguel to Bas Obispo. A floating trestle has been constructed above the locks at Pedro Miguel which permits trains to cross the canal and to keep up communication along the west bank of the waterway between Pedro Miguel and Bas Obispo, although after the abandonment of Culebra there will be very little use made of this line.

It was the intention of Colonel Goethals to run the new railroad through Culebra Cut on an offset in the bank some distance above the water line, but the slides made this out of the question. It was then decided to make a detour from Paraiso to Gamboa which carried the railroad back of Gold Hill and the other hills which border the east bank of the canal. This change in the alignment of the New Panama Railroad cost about a million dollars.

In addition to its work of doing a railroad and steamship business, and of furnishing trackage for the hundreds of thousands of dirt trains which had to move in and out of Culebra Cut in the disposal of spoil, the Panama Railroad Company also operated the commissary through which the employees of the canal commission were protected from the exactions of native merchants, and through which they could buy at a very small per cent. above wholesale prices. This work will be described in another chapter and needs only to be mentioned here. Still another activity of the railroad company was the operation of a hotel at Colon. For years it operated the old Washington House. This hostelry was better than the native hotels in Colon, but still left much to be desired both in size and in the character of its construction, especially in view of the demands of the large tourist traffic coming to the canal. Realizing the need of a really good hotel President Taft ordered Colonel Goethals to use a part of the surplus of the railroad company for the building of a modern hotel at Colon fitted for the accommodation of the tourist traffic. Colonel Goethals employed a good architect, and between them they designed a hotel that is, beyond question, the last word in tropical hotel architecture. Built of concrete, in a modified Mission style, and fitted with every modern hotel convenience, it is conducted on a scale which puts it on a par with the best hotels of the United States. Its wonderful ballroom, opening on three sides to the sea, is a thing of beauty and a joy forever. This ballroom and the one at the Tivoli Hotel at the other side of the isthmus perhaps have more to do with protecting Americans at Panama from the ravages of homesickness than any other condition on the Canal Zone.

It is probable that the patronage of the hotel in the future will be such as to make profitable the establishment of golf links at Gatun. In addition to this Gatun Lake will afford admirable fishing ground, and these things may make the isthmus an ideal tourist resort, to say nothing of their attractiveness to the passengers who pass that way on the ships of the world, and who will welcome a change during the day or two they must stay on the isthmus while their ships go through the canal, discharge cargo and take aboard supplies. The railroad will give the passengers who want a change, but who are on ships that do not stop, an opportunity to see the sights of the isthmus while their vessels pass through the canal. Passengers may take the cars and go across the isthmus in two hours, thus gaining from eight to ten hours for seeing the sights of the isthmus. The railroad will also be operated in such a way as to permit the commissary laundry to render efficient services to passing ships. A ship arriving at the Atlantic entrance from Europe can send its linen to the commissary laundry, which will launder it and send it to Panama in time to be taken aboard before the vessel leaves the Pacific end of the canal.

The Panama Railroad will be used in the future as an auxiliary in the operations of the big waterway. Closely paralleling the canal, it will move on short notice supplies and equipment from one point to another where they are needed. Built on high ground and in the most thorough manner, its cost of upkeep will not be heavy. When it is electrified its cost of operation will be very low. Under these conditions it will prove as useful to the completed canal as it proved to the construction forces in days gone by. In the prompt manœuvering of troops in case of hostilities the road will be invaluable to the United States.

Some writers have said that the building of the old Panama Railroad at a cost of $7,400,000 was a more creditable engineering achievement than the building of the new road for $9,000,000, in view of the advance in railroad engineering and the improvement of railroad building machinery. But this conclusion fails to take into consideration the tremendous amount of work done on the new road as compared with the old road. There is more material in a single fill on the new line than there was in all of the fills of the old line. There was as much excavation in a single three mile stretch of the new road as there was on the whole line of the old road; there is more steel in the rails of one mile of the the new road than there was in three miles of the old road. And so the comparison might be continued. The fact is, that the new Panama Railroad was built under those same standards of efficiency that characterized the construction of the canal, and as it takes its place alongside of the canal as a part of Uncle Sam's great interoceanic highway, it will but emphasize the wonderful success of the Americans at Panama.

CHAPTER XV

EARLY CANAL PROJECTS

Ancient Belief in the Existence of a Northwest Passage—Failure to Find It Turns Men's Thoughts Toward an Artificial Waterway—Spain, Holland, Central America, Great Britain, and America Devise Projects on Various Routes—Why They Failed—Famous Names Appear in Connection With Canal Schemes—United States Inclines Toward Nicaragua Route—France Takes up the Panama Project.

FROM a very early period in the exploration of the New World attempts were made to establish interoceanic communication by means of a natural waterway connecting the Atlantic and the Pacific. It will be borne in mind that the main object of Columbus's fourth and last voyage in 1502 was to discover a strait through which he could pass, as he thought, from the Atlantic to the Indian Ocean, and so sail around the world and get back to Spain by way of the Cape of Good Hope. This connecting water-passage he supposed to exist somewhere about Veragua or Nombre de Dios. He searched for it all the way from Cape Honduras to the cove of El Retrete, but of course he failed to find it for the very good reason that it did not exist; and then he turned back to Veragua to look for gold.

The belief in the existence of a strait in that locality or elsewhere long continued to exist. In 1506 Vicente Yáñez Pinzon, on the second voyage which he undertook on his own account, and in which he was accompanied by Juan Diaz de Solis, searched in vain for the strait from the Guanaja islands in the Gulf of Honduras to the Caria islands off Yucatan. Again, in 1508, Pinzon and Solis, with the celebrated pilot Pedro Ledesema aboard, went forth to seek in the south the passage which they had failed to find in the north and west. Sailing from San Lúcar on June 29, they reached Cape St. Augustine, and thence steered in a southwesterly direction as far as 40 degrees south latitude, and there gave up the quest, and returned to Spain in October, 1509.

Far to the south Magellan discovered in 1520 the strait which bears his name, but the remoteness of this passage prevented it from fully satisfying expectations. At a convention of the principal pilots and cartographers of Spain and Portugal, held in 1524, and usually spoken of as the Council of Badajoz, much was done to define more accurately the general shape of America; but the assembly was still obsessed with the belief in the existence of a waterway in a more central part of the continent. In accordance with this theory, Estevan Gomez, who had been with Magellan when he made his great discovery but had left him on entering the straits, was despatched by the Spanish government in 1525 to search for a passage in the north. He attempted to find it somewhere between Florida and Newfoundland, but of course he, like his various forerunners, was doomed to disappointment. After Cortés had conquered Mexico he was specifically enjoined by mandate from the King of Spain to use every means at his disposal to locate the waterway so much desired, and that was partly the object of the maritime expedition which he sent out along the Pacific coast in 1527. Gil Gonzalez Dávila and Andrés Niño, in their expedition of 1523, had also searched on the Pacific side for a strait through which the journey from the Atlantic to the Moluccas might be conveniently and directly made.

At length it was perforce, but grudgingly

and unwillingly, recognized that only in the extreme south, where it had been already discovered, or in the extreme north, where it remained to be discovered, was there a natural connection between the two oceans. What nature had failed to provide, man then set about to supply. Very early in the settlement of Tierra Firme, we find projects mooted for the construction of a ship canal. The first who is said to have conceived the idea was Alvaro de Saavedra Ceron, who had been one of Balboa's followers and subsequently became a lieutenant of Cortés. Even at a time when a natural strait was generally believed to exist, Saavedra is reported to have made different extensive surveys, between 1517 and 1529, as a result of which he advocated the construction of a ship canal on one of four routes which he specified, namely, 1, from the Gulf of San Miguel to Urabá; 2, from Panama to Nombre de Dios; 3, through Lake Nicaragua; and 4, across Tehuantepec. Saavedra died in 1529, before he was able to submit his report to Charles V. We are also told that in 1520 two Flemish engineers surveyed the Isthmus with a view to the construction of a waterway through it, but reported against such a project. When Pedrarias sent Martin Estete and Gabriel de Rojas to explore the San Juan River in 1528, it is quite likely that his fertile brain had already formed the conception of linking the Atlantic to the Pacific through the province over which he ruled. On their return from their journey of investigation, these two officers recommended a canal around the falls of the San Juan River, passing through Lake Nicaragua, and to be completed thence by another canal to the Pacific Coast. But Pedrarias's many other activities prevented him from putting the project into execution; and although it engaged the attention both of the home government and of the government of the colony for some years, nothing came of it in the end.

In 1534 Antonio de la Gama, governor of Panama, made an important preliminary move by causing the Chagres River to be made thoroughly navigable to Cruces. In the same year Pascual de Andagoya, inspector general of the Indies, in obedience to a *cédula* from Charles V, caused sundry surveys for a canal to be made, but eventually reported that it was impossible to build one across Panama on account of the enormous expense which it would entail. Sixteen years later Antonio Galvao, the Portuguese navigator, came forward in support of the opinion that interoceanic communication could be established along any one of four routes, namely, Darien, Panama, Nicaragua, or Tehuantepec; and in 1551 Francisco Lopez Gomara, the Spanish historian, forcibly urged on Charles V the advisability of the undertaking. Gomara suggested to his royal master that three routes were feasible—Tehuantepec, Nicaragua, and Panama. He wrote: "It is true that mountains bar the passes, but if there are mountains, there are also arms; take but the resolve, and the means to do it will not be lacking; the Indies toward which the passage will be opened will furnish them. To a King of Spain, with the riches of the Indies at his doorway, when the end to be obtained is the commerce in its products, the barely possible becomes easy."

At one time Charles the Fifth's son, Philip II, seemed inclined to undertake the construction of a canal, but Juan Bautista Antonelli, the engineer whom he sent out in 1567, having submitted an unfavorable report regarding the Nicaraguan route, the matter ended. Thereafter Philip changed his policy completely, and, moved thereto by the fear that such a canal as was contemplated would render his American possessions still more exposed than they were to the attacks of the enemies of Spain, he absolutely forbade the making of any move having for object the construction of an interoceanic waterway.

The question was reopened in 1616 by Philip III, who directed Diego Fernandez de Velasco, governor of Castilla del Oro, to make a survey of the route via the river

Damaquiel, and also of that by the Gulf of Darien and the Atrato River to the Gulf of San Miguel; but nothing resulted, and it is not definitely known whether Velasco even sent in a report. The Tehuantepec route was surveyed on behalf of Spain in 1715 and again in 1774, as was that of Nicaragua in 1779, but without leading to the undertaking of any work in either case.

Spain came to the fore again in 1788 with a project for a canal on the Caledonian Bay route, but without accomplishing anything except having a survey made by Manuel Milla; and finally, apparently in a very earnest way, in 1814, with a decree for the construction of an isthmian canal, but the movement for independence among her American possessions rendered her contemplated action then and forever impossible to her.

Not to Spain, therefore, but to some other nation were to fall the task and the credit of the building of the much-talked-of artificial waterway. The British came into the project unofficially towards the close of the seventeenth century, for while Paterson was at New Edinburgh on Caledonia Bay, in 1698–99, one of his many aggrandizement projects was the construction of a canal; but the failure of his Darien colony involved the failure of all the subsidiary plans. In 1780 Great Britain came forward herself. In that year she planned an attack on Nicaragua with the double object of crippling Spain in her American colonies and of securing control of the direct communication between the two oceans through Nicaraguan territory. The expedition, which was under command of Major Polson, and had Horatio Nelson, the future hero of the Nile and Trafalgar, among its officers, had at first some success; but finally was so weakened in numbers and stamina by malaria and fevers brought on by the rainy season that it had to make an inglorious retreat.

Humboldt's suggestions and proposals in 1803–08 had, from the greatness of their author, attracted attention to the question anew, and not long after their emancipation, the countries forming the Central American Confederation invited the coöperation of the United States in building a canal. An envoy deputied in 1825 by Henry Clay, then Secretary of State, to investigate the practicability of constructing a canal through Nicaragua, reported that, owing to the unsettled conditions at that time prevalent, it would not be advisable to enter on the undertaking. In default of the coöperation asked for, the congress of the Confederation, anxious to have a canal constructed across Nicaragua, gave for that purpose a concession to one Beninski, a Frenchman, who, failing to do anything himself, transferred his rights to an American syndicate, known as the Central American and United States Atlantic and Pacific Canal Company. There were some eminent engineers and capitalists in this combine, but for want of government support they were not able to accomplish anything.

The next competitor was New Granada, and its objective point was naturally in its own territory. President Bolivar having in 1826 given to Baron Thierry, a Frenchman, a concession which came to nought for want of capital to work it, commissioned in the following year Lloyd and Falmark to make that exploration which resulted in the expression of their belief, already referred to, that at least a railway, and possibly a canal, was practicable between Chagres and Panama. It will be noticed that the route they examined and selected was nearly the same as that which the Panama Railroad Company utilized in constructing its line across the Isthmus. The political situation in New Granada was, however, unfavorable to the inception of either undertaking, and accordingly the matter ended with Lloyd and Falmark's report.

The King of Holland then stepped in, and his representative, Gen. Werweer, a Belgian officer, having secured a concesson in 1829, there seemed a fair prospect that at last a canal would be constructed; but the war which separated Belgium from

Holland soon afterwards broke out and compelled the abandonment of the Dutch project. Morazon, president of the Central American Confederation, caused a survey to be begun in 1837, but the work was interrupted by Morazon's fall. It was continued without result by Nicaragua on its own account.

In the meantime the United States had by 1835 become very thoroughly interested, and the Senate adopted a resolution in favor of a canal on the Nicaraguan route. Thereupon President Jackson sent Charles Biddle to make a survey and to negotiate for a Nicaraguan concession. Biddle, however, as has been already told, did not visit Nicaragua at all, but was so favorably impressed by what he saw of the Panama route that he hastened to Bogotá and secured a concession for a railroad across the Isthmus. This action on his part led to Biddle's being practically repudiated by the United States Government, and the panic of 1837 also supervening, he was, as we have seen, unable to go forward with his railroad project.

In 1838 Capt. Edward Belcher of the British Navy recommended the construction of a canal having its Pacific outlet in the Bay of Fonseca. This suggested route aroused attention in the United States, and in 1839 President Van Buren sent John L. Stephens on a confidential mission to Central America. His instructions were to investigate the feasibility of a canal on some one of the suggested routes, and, if he found conditions favorable, to negotiate for a concession. The conclusion Stephens arrived at was that, owing to the existing disturbances, it was not then advisable to attempt the construction of a canal. At the same time he recommended for future use the Lake Nicaragua route, and estimated that the cost of constructing a canal there would be $25,000,000.

A French company having obtained in 1838 from New Granada a concession for, among other things, the construction of a trans-isthmian canal, and having announced the discovery of a pass through the mountains only thirty-seven feet above the level of the sea, the French minister for foreign affairs in 1843 commissioned Napoleon Garella, an engineer, to visit and study the Isthmus and investigate this claim. Garella could not find a pass at any such height, and, condemning the project in hand, recommended, as related in the previous chapter, a canal from Limon Bay to the bay of Vaca de Monte. This canal would have required a tunnel over three miles long under the Ahogayuega ridge. At its summit it was to be 135 feet above the sea, and the ascent and descent were to be secured by thirty-five locks. The total cost was estimated at $40,000,000. This project failed to materialize.

Then, in 1844, Nicaragua tried to interest France in a canal through its territory, and sent Francisco Castellon to put the matter before Louis Philippe; but that monarch gave the matter only scant attention. In 1846 Louis Napoleon, having written in his prison of Ham an essay on the subject, continued his efforts to secure from the Nicaraguan government a concession to construct the "Canal Napoleon de Nicaragua," and offered to undertake the work, if released; but, fearing the consequences, the French government refused to grant the necessary condition. When Napoleon effected his dramatic escape from the fortress, other interests than distant Nicaragua naturally occupied him.

The seizure of San Juan del Norte and Tiger Island by Great Britain, followed by other British aggression in Central America, aroused the United States to offsetting action, and in 1849 President Polk sent Elijah Hise as a special envoy to Nicaragua. With that country Hise negotiated a treaty, by the terms of which the United States, or its citizens, were given the exclusive right to construct, operate and control a transit way of what sort soever across Nicaragua, the consideration being that the United States should guarantee to Nicaragua its independence. This treaty ignored certain claims set up by Great

Britain, and, the British minister having entered a protest, the treaty was not submitted to the Senate.

Treaties negotiated with Nicaragua and Honduras by Ephraim George Squier on behalf of the United States were also objected to by Great Britain and failed of ratification. Further complications were brought about in the same year (1849) when some New York capitalists organized the "Compañia de Tránsito de Nicaragua" for the construction of a canal through Nicaragua.

All the points in dispute were, however, settled in 1850 by the Clayton-Bulwer treaty, which provided that neither Great Britain nor the United States could occupy, fortify, colonize, or exercise dominion over Nicaragua, Costa Rica, the Mosquito Coast, or any other portion of Central American territory, except Belize, nor make use of a protectorate in any form, and further perpetually guaranteed the neutrality of the canal or other interoceanic transit which should thereafter be constructed. The entrepreneurs, whose affairs had helped to bring about this important international treaty, failed to construct the canal; but having amalgamated with other capitalists in 1851 under the title of the "Accessory Transit Company," they placed steamers on both oceans, and utilizing the river San Juan and Lake Nicaragua, and establishing a coach route of thirteen miles to connect the lake with San Juan del Sur on the Pacific, they did a brisk business, as well as providing a public utility, in transporting passengers, until 1869, when the company discontinued its operations.

Colonel Orville Childs, the engineer of the Accessory Transit Company, surveyed a new route in 1851, and in the following year he presented to President Fillmore a report in which he recommended a canal from the mouth of Lojas River, through the valley of the Rio Grande, to Port Brito. In 1852, also, S. Bayley proposed to construct from La Virgen to San Juan del Sur a canal along a route which followed in part an earlier one recommended in 1843 by John Baily. In 1853 Squier suggested a revival of Belcher's route, utilizing Lakes Nicaragua and Managua and passing through the Conejo valley and the Estero Real to the Bay of Fonseca.

In 1858 Felix Belly, a Frenchman, secured for his firm, Belly, Milaud, et Compagnie, a contract from Nicaragua for a canal along the Sapoa River to Salinas Bay, a route which had been recommended to Costa Rica by Orsted in 1848. This firm assigned its rights to the International Canal Company, but, as neither the original grantee nor its successor did anything, the Nicaraguan government cancelled the contract in 1868 and transferred it to Michel Chevalier, another Frenchman, who had for some years previously been prospecting in Central America on behalf of the Emperor Napoleon. Chevalier insisted, as an essential preliminary, that the contract should be ratified by the congress of Costa Rica, through a portion of whose territory the canal was to run. This ratification was granted, but not until 1869, and before anything was done to construct the canal, the great Franco-Prussian War of 1870–1871 broke out, and the downfall of the empire and the chaos which that event engendered in France swamped all Chevalier's hopes of success in financing his concession.

In 1850 Dr. Edgar Cullen, of Dublin, Ireland, received a concession from New Granada for a canal along the Caledonian Bay route first suggested by Paterson in 1698. The glowing, but, as afterwards appeared, unwarranted, reports given out by Cullen, and afterwards by Lionel Gisborne, as to the advantages of this route, induced the United States government to send Lieutenant Strain of the United States navy to survey that section of the country. Strain and his party started from Caledonia Bay for the Gulf of San Miguel in January, 1854, but met with such terrible hardships that several of their number actually died of starvation. The survey was made, however, and showed moun-

tains so high as effectually to prevent the construction of a canal without excessive tunnelling.

In 1857 President Buchanan sent Lieutenant Nathaniel Michler of the army and Lieutenant T. A. Craven of the navy to survey the Atrato River route. The report submitted by Michler was favorable, and estimated the cost of a canal at $134,000,000, while on the other hand Craven's report declared the route to be quite impracticable.

In 1869 President Grant enunciated the doctrine of "an American canal under American control," stating that he regarded it of vast political importance to the United States that no European government should hold such a work. He then appointed an Interoceanic Canal Commission, under whose direction four surveys were undertaken and carried to completion. The net result of these surveys was that the Caledonian Bay route and the San Blas route were condemned as impracticable; that one route in the Atrato River valley was pronounced impossible and another, that to Chiri-Chiri Bay, was highly recommended; that the Tehuantepec route was found to be practicable, but prohibitive as to cost; that the Childs route through Nicaragua with Brito as terminus was recommended; and that a lock canal from Limon Bay to Panama was declared practicable, but that the Chagres River made a sea level canal impossible on that route. Further surveys over most of those routes were then ordered; and finally, in 1876, the Interoceanic Canal Commission, after carefully considering all the rights of the various surveying parties, made a unanimous recommendation in favor of the Nicaragua route from Greytown to the San Juan River, through Lake Nicaragua, along the valleys of the Rio del Media and Rio Grande, to Brito on the Pacific coast.

Such, in brief, was the record made by the nations in their fruitless efforts to execute the work of constructing an interoceanic canal. Numerous other minor attempts were made by individuals, supported often by governments, but doomed to early disappointment, and hardly deserving even passing mention. At this juncture, in 1875, the active and ambitious spirit of France began to be aroused anew, and the success that had linked the names of de Lesseps and Suez together induced Frenchmen to believe that they could conquer the cordilleras of the New World.

CHAPTER XVI

DE LESSEPS'S COLOSSAL FAILURE

LIEUTENANT WYSE SECURES A CONCESSION FROM COLOMBIA—DE LESSEPS BECOMES INTERESTED—INTERNATIONAL SCIENTIFIC CONGRESS FOSTERS PANAMA ROUTE—ORGANIZATION OF COMPAGNIE UNIVERSELLE DU CANAL INTEROCÉANIQUE DE PANAMA—SEA-LEVEL CANAL BEGUN—BOUNDLESS ENTHUSIASM IN FRANCE—THE FIGHT WITH DISEASE—EXTRAVAGANCE AND GRAFT—THE BUBBLE BURSTS—CRIMINAL PROSECUTIONS—DE LESSEPS SENTENCED TO PRISON—NEW PANAMA CANAL COMPANY ORGANIZED—MARITIME CANAL COMPANY OPERATES IN NICARAGUA—UNITED STATES TURNS TO THAT ROUTE—CLAYTON-BULWER TREATY SET ASIDE—PLANS FOR NICARAGUA CANAL INITIATED.

THE Atlantic-Pacific canal question was fully discussed in all its bearings at the Congress of Geographical Sciences held in Paris in 1875. As a result, a French company, the Société Civile Internationale du Canal Interocéanique, formed for the purpose of making the necessary explorations, sent Lieutenant Lucien Napoleon Bonaparte Wyse and a party of assistants to decide on the best route and, having decided, to secure a concession. The route from Colon to Panama was selected, and on May 18, 1878, Wyse obtained from the Colombian government for his company the exclusive privilege of constructing a canal, subject only to the existing rights of the Panama Railroad Company. The concession was to last for ninety-nine years beginning from the first collection of tolls on vessels passing through the canal. Two years were allowed for the formation of a company, and twelve years for the construction of the canal.

Thereupon Ferdinand de Lesseps, who had gained great renown by the construction of the Suez Canal in 1859–1869, convened at Paris the International Scientific Congress, which met on May 15, 1879. After debating the subject for a fortnight and discussing seven separate schemes, the Congress, which was dominated by de Lesseps, decided that a sea-level canal should be constructed from Colon to Panama and estimated the cost at $208,000,000. To take over the Wyse concession, and carry out the work, the Compagnie Universelle du Canal Interocéanique de Panama was formed, with a capital of $60,000,000, and was placed in control of de Lesseps. On January 1, 1880, the construction of the canal was formally inaugurated; in February of the following year the engineers were at the work in earnest.

At the outset the company was confronted with difficulties in connection with the Panama Railroad, which refused to carry passengers and freight unless at the ordinary rates, and, in addition, held such rights as to make the canal concession of very little value unless there was cordial coöperation between the two companies. Under such circumstances there was obviously only one thing to do, namely, buy out the railroad, rights, building, and equipment; and this was done for a consideration of some $25,500,000.

In adopting a sea-level instead of a lock canal, de Lesseps and his associates had run counter to the deliberate opinion of many experienced engineers, and some of those most competent to judge thought they saw danger ahead. But all warnings were lost in the vortex of the popularity of the hero of Suez. With exuberant confidence de Lesseps waved every obstacle aside, and his reputation was so great and his optimism so infectious that the public gladly followed his lead. Hundreds

of thousands of his fellow-countrymen rushed to invest their savings in the company at the head of which was the great Frenchman. The construction of the canal was thus entered on with great enthusiasm and high hopes.

Several causes, however, conspired to militate against its success. The principal of these may briefly be described as lack of foresight, inability to cope with disease, extravagance, and bribery and corruption. Thousands of laborers were despatched to the scene of action without any adequate preparation for their housing or feeding; stores, supplies, and implements were recklessly purchased without due attention to actual needs. At that time it had not been discovered that one kind of mosquito was the disseminator of malaria and another of yellow fever, and, although two splendid hospitals were built, the loss of life from those diseases was phenomenal. In fact, owing to a pardonable want of knowledge of medical facts that were not fully established until 1898 and 1900, respectively, the hospitals themselves became propagators and disseminators of disease.

The expenditures in salaries, equipment, and expenses, especially for the higher placed officials, were boundless. Finally, as investigation afterwards brought out, there was so much money spent on secret commissions and in other corrupt ways that it has been said with some show of truth that not more than one-third of the total amount expended was actually laid out on the canal. With all these factors combined against success, the wonder is, not that the French failed, but that they achieved so much.

In 1887 it became evident that a sea-level canal could not be built at a reasonable cost nor within a reasonable time, and accordingly there was substituted a plan for a lock canal, estimated to cost $300,000,000. Work was continued along the latter line until December, 1888, when the company suspended payment and became bankrupt. It was dissolved by a judgment of the Tribunal Civile de la Seine on February 4, 1889, and a receiver was appointed by the court to take charge of its affairs. A sum of $262,000,000 had been spent, and in eight and a half years less than a quarter of the canal had been constructed. There was naturally a great scandal and a great outburst of popular indignation in France. Criminal charges were brought against de Lesseps, and in 1893 he was condemned to five years' imprisonment—a sentence which, owing to his advanced age and honorable record, was never enforced. Many others were also brought to trial; some committed suicide, others were fined and sent to prison.

Investigation proved that between 1881 and 1887 seven different directors general had been appointed; that white mechanics had been paid $5 a day, skilled black laborers $2.50 a day, and unskilled black laborers $1.75 a day. Disease and death scattered the working forces, and the supervising heads lost interest in the enterprise and transferred their activities to the pleasures of life in the city of Panama. The Dutch company which had contracted to do the work of excavation agreed to remove 793,000 cubic yards a month for the first eighteen months and 429,000 cubic yards a month thereafter. It was never able to handle more than 130,000 cubic yards a month.

The trial in Paris disclosed the fact that $400,000 had gone to the genius who proposed a lottery loan for the purpose of keeping the canal company afloat; $400,000 went for "publicity;" $580,000 was charged to "banking expenses;" and $280,000 was paid to politicians, journalists, and members of the chamber of deputies. The Minister of Public Works had demanded $200,000 for his services, and was paid $75,000. Baron Reinach was paid $1,200,000 to float a loan of $120,000,000, and only half of this loan was subscribed. M. Eiffel, builder of the famous Eiffel tower, was drawn in as the new contractor for the lock-type canal, and a lottery loan was floated. But the money was soon gone, and the collapse

followed. It was shown that of the $262,000,000 raised by the French people, less than $100,000,000 had been expended at Panama. Salaries and office expenses consumed $80,000,000; it cost $32,000,000 to float the loans; and the expenses in Paris were over $75,000,000.

The receiver having finally suspended the works in May, 1889, applied his energies to saving whatever was possible from the wreck, and for that purpose assisted in the reorganization of another company. But this was now by no means easy to do, and it was not until 1894 that the new Panama Canal Company with a capital of $10,000,000 was successfully established. In the meantime a fresh concession for ten years had been obtained from Colombia in 1890, and in 1893 a further extension had been granted on the understanding that the canal should be completed by October 31, 1904. In 1900 this term was finally extended to 1910 by the President, but not by the congress, of Colombia—a fact which at a critical juncture in a later period was seized upon to make the concession appear invalid.

The New Panama Canal Company did excellent work, and with a comparatively small capital excavated about 11,400,000 cubic yards, as well as making engineering surveys which were afterwards found to be of the greatest value. It was, however, hampered in many ways, principally for want of capital, and for some time towards the end it could do little more than the minimum amount of work required to save appearances and keep its concession alive.

In the meantime the United States, still anxious to build an isthmian canal, had sent Lieutenant Menocal in 1887 to survey the Nicaraguan territory once more, with instructions finally to determine the best route for a canal. The route selected ran from Greytown on the Atlantic to Brito on the Pacific. Concessions were obtained from both Nicaragua in 1887 and Costa Rica in 1888. A bill introduced in Congress in 1888, for chartering the Maritime Canal Company to work those concessions, became law in February, 1889, at a time when the failure of the first French Company operating in Panama was known to be absolute.

The Maritime Company was organized as speedily as possible with a capital of $150,000,000 preferred and $100,000,000 common stock. It commenced operations at Greytown in June, 1890, and erected wharves and warehouses, as well as actually constructing a temporary railroad, a telegraph line, and about three-quarters of a mile of a canal. The panic of 1893 then supervened, and the company, involved in financial difficulties, was obliged to discontinue its work.

In June, 1897, a Canal Commission was constituted by the United States Congress and the sum of $300,000 was voted for its expenses. This commission investigated the Nicaraguan route again, and in 1899 recommended its adoption; but Congress required more information before acting, and in June, 1899, appointed another Canal Commission with an appropriation of $1,000,000 to conduct investigations both at Panama and Nicaragua. Its report, submitted on December 4, 1900, discussed fully the merits of both routes. It recommended the Nicaragua route and estimated the cost of a canal there at $200,540,000. Its estimate for a canal through Panama was $142,342,579, but the commission had found no way to complete ownership or control thereof except at a cost that would make its total expenses much greater than the canal on the Nicaraguan route. This was because the New Panama Canal Company had placed a selling value of $109,000,000 on its property and rights, and at that time refused to accept less. Congress then proceeded to consider afresh the Nicaraguan project, and soon a convention was signed between representatives of the two governments having in view the construction of a canal through Nicaragua.

In the meantime Secretary Hay, under direction of President McKinley, began negotiations with Great Britain for the

modification or abrogation of the Clayton-Bulwer treaty of 1850. This treaty had been a stumbling-block in the path of the United States almost from the date of its ratification. It had caused friction between the two nations, and had prevented the United States from acquiring exclusive control of any canal route. Now that the way had been paved for a canal through Nicaragua, the United States was ardently desirous of beginning the work, since the voyage of the *Oregon* in the Spanish-American War had aroused the American people to the need of a short passage from one coast to the other.

Great Britain's foreign policy at that time was directed by Lord Lansdowne, who made known his willingness to come to terms with the United States. After much negotiation a treaty was drawn up and signed by Secretary Hay and Sir Julian Pauncefote, British Ambassador to the United States. It provided, however, that the United States should not fortify any canal which it might construct, and the Senate took exception to this provision. The treaty was amended by the Senate to conform to its opinions, and the British government thereupon declined to ratify the treaty.

Renewed negotiations were begun by Secretary Hay, which were continued after the death of President McKinley and the incoming of President Roosevelt. A new treaty, with the same plenipotentiaries as signers, was concluded. It met the approval of the Senate, and was duly ratified by both governments. This treaty gave to the United States the exclusive right to build and control an isthmian canal, and to defend it, with the proviso that the general principle of neutralization contained in the Clayton-Bulwer treaty should be maintained—that is, that the vessels of all nations observing the rules laid down by the United States should be permitted to pass through the canal on equal terms; that the canal should not be used for warlike purposes; and that belligerent vessels should be passed through in accordance with the general rules of neutrality.

With the Hay-Pauncefote treaty ratified, the way seemed to be clear for the construction of the Nicaragua canal. The commission had unanimously favored it, the diplomatic obstacles had been removed, Congress was ready to appropriate money for the work, and the people demanded it. Panama appeared to have been abandoned forever by the Americans.

CHAPTER XVII

HOW PANAMA TRIUMPHED OVER NICARAGUA

A New Figure Appears in Canal History—William Nelson Cromwell's Efforts in Favor of Panama—He Prevents Adoption of Nicaragua Route—French Company's Excessive Demand—Death of McKinley—Hay-Pauncefote Treaty Clears the Way for Nicaragua—Company Elects a New President and Submits a New Offer—House Passes Nicaragua Bill—Canal Commission Favors French Company's Offer—Senator Hanna Supports Panama—Attack Upon Validity of Title—Colombia Blocks the Way—Its Objections Removed—Senator Spooner Introduces Bill for Alternative Choice of Routes—It is Substituted for Nicaragua Bill.

At this juncture there appeared prominently in canal history a new figure—a man who had been busily at work for four years in behalf of the Panama route, but whose work was unknown to most Americans. Mr. William Nelson Cromwell, who combined in his makeup unusual and brilliant qualities as a lawyer, diplomat, and financier, had been retained in 1896 as American counsel by the Compagnie Nouvelle du Canal de Panama (New Panama Canal Company). He had thrown himself into a complex and disheartening task with remarkable tenacity of purpose and clearness of vision. His task was nothing less than that of inducing the United States to adopt the Panama route—to adopt it after the very name of Panama had become a synonym for disease, failure and disaster.

During the four years from 1896 to 1901, Mr. Cromwell had accomplished much. It was due to him that the dangers of the Clayton-Bulwer treaty were made clear, although, if he had stopped there, the net result of his labors would have been to facilitate the construction of the rival canal at Nicaragua. He fought the Nicaragua project in Congress, in the press, and through diplomatic channels, not in opposition to the building of a canal, but for the sake of obtaining a hearing for Panama. He succeeded in preventing the passage of a bill by the House of Representatives—already passed by the Senate—providing for the Nicaragua canal. He brought about the appointment of a new canal commission to study the Panama route and to confer with the New Panama Canal Company. He induced Colombia to enter a protest against the construction of the Nicaragua route until the international interests involved at Panama could be thoroughly studied.

Mr. Cromwell's efforts in behalf of the Panama route were nearly brought to nought by the refusal of the French company to sell outright its property and rights. He was confronted with the imminent failure of all his labors. He conceived the plan of Americanizing the company by obtaining a charter under the laws of an American state. This work occupied him many months.

Public sentiment in the United States seemed to be overwhelmingly in favor of the Nicaragua route. Mr. Hepburn, in the House of Representatives, and Senator Morgan, of Alabama, were champions of Nicaragua. They made every effort to push through an act providing for the Nicaragua canal, without waiting for the new commission's report. The House on May 2, 1900, had passed the Nicaragua canal bill, and Senator Morgan employed all his resources to bring it to a vote in the Senate. He was defeated by the narrow margin of twenty-eight to twenty-one votes, on May 14, 1900.

After the presidential election of 1900

and the reconvening of Congress in December of that year, the canal controversy was resumed. The French company had not been brought to make an out and out offer of sale; it insisted that its concession prohibited the sale of the property without the consent of Colombia; and it suggested that, if permitted to sell, the price should be fixed by arbitration or valuation. The American commission was not satisfied with this proposal; and again it appeared that the Panama route would be abandoned. Mr. Cromwell visited Paris and emphasized the fact that the United States would not deal with the company unless a definite price were fixed for an outright sale. He obtained from Colombia an expression of willingness to enter into a treaty with the United States, authorizing the transfer of the French company's property. But the company refused to fix a definite price, and on July 1, 1901, for reasons of its own, it undertook to carry on the negotiations with the United States without the assistance of Mr. Cromwell.

In September, 1901, President McKinley was assassinated. The advent of Mr. Roosevelt changed the situation somewhat; the canal commission delayed its report; public opinion was diverted for the time being. In October the president of the French company came to the United States, met Rear Admiral Walker, chairman of the Canal Commission, and made a conditional offer to sell the company's property for $109,000,000. This offer was greatly in excess of the commission's estimate of the value of the property. On November 16, 1901, the commission unanimously reported against Panama and recommended the Nicaragua route.

Congress met in the following month, and immediately the champions of the Nicaragua route became active. Col. Hepburn introduced a bill appropriating $180,000,000 for the construction of the Nicaragua canal. On December 10 a treaty between the United States and Nicaragua was concluded, providing for the construction of the canal. On December 16 the Senate ratified the Hay-Pauncefote Treaty, removing the last obstacle to the building of the Nicaragua canal. On December 17 the House, by unanimous consent, fixed upon January 7, 1902, as the date for consideration of the Hepburn bill.

The rejection of the French company's offer by the canal commission resulted in the resignation of the president of the company upon his return to Paris. The directors were aghast at the condition of affairs. The construction of the rival canal by the United States meant complete disaster to them. Their concession would have been worthless; their property at Panama would have become a junk-heap. They elected M. Bô president of the company, and immediately sought for means whereby the negotiations with the United States could be reopened. On January 4, 1902, three days before the date fixed for the canal debate in the House, the company cabled to the canal commission, offering to sell outright all its rights and properties for $40,000,000, the sum estimated by the commission to be a reasonable price for the property.

The House of Representatives, however, was in no mood to listen to the French company. It regarded the former offer as grossly excessive, and it looked upon the new offer as a ruse to gain time. Thereupon, on January 9, by the overwhelming vote of 309 to 2, it passed the Hepburn bill.

Senator Morgan, who was then chairman of the Committee on Interoceanic Canals, prepared to push the bill through the Senate. President Roosevelt, however, called the canal commission together on January 16 to consider the new offer from the New Panama Canal Company; the commission two days later reported that, in view of the reduced and more definite terms, the Panama route would be preferable; and on January 20 the President transmitted this report to Congress.

Thus the New Panama Canal Company was given a new opportunity. It immediately engaged Mr. Cromwell as its American counsel, and he took up again the task of

bringing all the conflicting opinions together in favor of Panama. He was confronted at the outset with a most determined opposition, which attempted to show that the French company's titles were invalid; that Colombia really owned the rights offered by the French company; that the question had been closed and that if the United States was ever to possess a canal, it must go on with the Nicaraguan project. And indeed, public sentiment in the United States seemed to support this contention, in spite of the commission's report in favor of Panama.

Mr. Cromwell was fortunate in finding a stalwart supporter of the Panama route in Senator Mark Hanna. The Ohioan was a member of the Committee on Interoceanic Canals, and he had carefully studied the question of building a waterway between the oceans. His practical turn of mind caused him to support the canal commission on intricate details as to routes, since he relied upon their technical training and personal knowledge. He favored the Panama route because it was more definitely known and its cost more accurately estimated; because it was shorter and more secure from accident; and he was ready to fight valiantly for it if he could be convinced that the title was perfect.

The chairman of the Senate committee, Senator Morgan, had begun hearings for the purpose of breaking down the weight of the canal commission's recommendation in favor of Panama. He contrasted this report with preceding ones in favor of Nicaragua, and insisted that one of the commissioners, Professor Haupt, had been virtually compelled to sign the report in favor of Panama.

It was vitally necessary for the cause of Panama that time should be gained. The Senate committee was in favor of Nicaragua; Colombia had not formally agreed to the transfer of the French company's property, and it was necessary to negotiate an agreement to that effect; and a vote in the Senate would have been fatal. Here the resourcefulness of Mr. Cromwell, aided by Senator Hanna, was most effective. They demanded that the hearings should be widened to include consideration of the Panama route and the reason why it was preferred by the canal commission. Senator Morgan was compelled to prolong the hearings which he himself had begun, and the sessions ran over several weeks. During this period Mr. Cromwell prepared an exhaustive defense of the New Panama Canal Company's titles, initiated a movement for the negotiation of a treaty with Colombia, and began to formulate a plan for the passage of an act which would permit the President of the United States to purchase the New Panama Canal Company's property, provided the title was found to be perfect and its transfer agreed to by Colombia.

Great difficulties began to appear. Senators were doubtful as to the validity of the titles; they insisted that Colombia should bind herself to agree to the transfer; and they also insisted that the stockholders of the French company should ratify the transfer. Senator Spooner, of Wisconsin, who favored a plan for empowering the President to choose either route, was insistent upon these points. Then came the announcement that Colombia had served notice upon the French company that it must not sell its property without Colombia's consent, to which was coupled a demand for an "indemnity" of $20,000,000 as the price of this consent. Colombia then sent a new envoy to the United States, whose mission it was to block the negotiations unless Colombia was paid an indemnity of from $10,000,000 to $20,000,000 and $1,000,000 a year. The alternative was a threat to annul the French company's concession on the ground that its extension had been made by legislative decree, and not by the Colombian congress.

After long conferences between Mr. Cromwell and the new Minister, Mr. Concha, the latter made a statement that the notice served by Colombia upon the French company did not imply opposition to the sale of the property to the United



PRESIDENTS UNDER WHOM PANAMA CANAL WAS CONSTRUCTED

1. William McKinley.
2. Theodore Roosevelt.
3. William H. Taft.
4. Woodrow Wilson.







CHIEF ENGINEERS

1. Col. George W. Goethals, Chief Engineer, 1907-1914.
2. John F. Wallace, Chief Engineer, 1904-1905.
3. John F. Stevens, Chief Engineer, 1905-1907.

States, provided Colombia's interests were protected. This paved the way to an understanding between the company and the Colombian government, and then negotiations were opened between Secretary Hay and Minister Concha, resulting in an agreement under which the United States and Colombia signified their willingness to enter into a treaty which would provide for the transfer of the French company's property to the United States and the payment of a satisfactory sum to Colombia. This agreement was duly brought to the attention of Congress.

The hour came for a vote on the Hepburn bill in the Senate. Senator Spooner had previously introduced a bill placing the choice of routes in the hands of the President, and authorizing him to pay $40,000,000 to the French company after satisfying himself as to the validity of its title. The question in the Senate was upon the adoption of the Spooner bill as a substitute for the Hepburn bill; and after heartbreaking complications and delays, the die was cast. The vote was taken on June 19, 1902, and it stood forty-two to thirty-four in favor of the Spooner bill.

The Senate and House then locked horns. The House rejected the Senate substitute, and a conference committee was appointed. This committee labored for a week, at the end of which time the House conferees yielded. The House thereupon concurred in the Senate amendment substituting the Spooner bill—and the Panama Canal was brought into being. The President signed the bill on June 28, 1902, and negotiations were immediately entered into with Colombia for the conclusion of a treaty in accordance with the Hay-Concha agreement and the terms of the Spooner act.

CHAPTER XVIII

CONTROVERSY WITH COLOMBIA AND ACQUISITION OF THE CANAL ZONE

COLOMBIA DEMANDS INDEMNITY FROM FRENCH COMPANY—MINISTER CONCHA WITHDRAWS—MAKING OF THE HAY-HERRAN TREATY—FIGHT OVER ITS RATIFICATION—COLOMBIA REFUSES TO RATIFY—ATTEMPTS TO ANNUL FRENCH COMPANY'S CONCESSION—PANAMA DECLARES ITS INDEPENDENCE AND IS RECOGNIZED BY UNITED STATES—TREATY WITH PANAMA SIGNED BY MR. HAY AND M. BUNAU-VARILLA—COLOMBIA OFFERS NEW TERMS—SALE OF FRENCH PROPERTY EFFECTED AND UNITED STATES TAKES POSSESSION—INEFFECTUAL EFFORTS TO COMPOSE DIFFERENCES WITH COLOMBIA.

WE have now to deal with the tortuous negotiations between the United States and Colombia, which had for their object the making of a treaty facilitating the construction of the canal at Panama. The failure of this treaty, the secession of Panama from Colombia, and the making of a treaty with the new republic brought about the construction of the Panama Canal. Colombia's refusal to ratify the Hay-Herran treaty was regarded by the United States as a great blunder, with certain sinister aspects which gave rise to acrimonious exchanges between the two governments. Colombia, on the other hand, felt that it had been deprived of its territory and valuable properties without due compensation, and it demanded satisfaction. Efforts were made by four American Secretaries of State—Messrs. Hay, Knox, Root, and Bryan—to compose the differences between the two governments, but their negotiations were and have been fruitless up to the present time.

Colombia was extremely suspicious in regard to the transactions between the New Panama Canal Company and the United States government. When the Spooner act was passed in June, 1902, and the way was clear for the conclusion of a treaty between Colombia and the United States, Minister Concha received instructions of a drastic nature, requiring him to demand from the United States a payment of at least $600,000 a year in perpetuity, and to insist upon other conditions which would have made the treaty extremely burdensome upon the United States. Mr. Concha was openly unfriendly in his attitude, but through the persistent efforts of Mr. Cromwell as an intermediary, he consented to continue the negotiations until July, 1902, when a tentative understanding was reached.

In the meantime the United States, through Mr. Knox, who was then Attorney-General, made a thorough investigation of the titles of the New Panama Canal Company. Mr. Knox, Mr. Cromwell, and their associates went to Paris and spent two months in this work. The inquiry proved to the satisfaction of the United States that the company's titles were valid; that the stockholders would approve the transfer, and that the liquidator of the old company, with the permission of the Civil Tribunal of the Seine, would give his approval; and that nothing remained but the conclusion of the treaty with Colombia in order to take over the property and pay the price agreed upon.

Minister Concha's attitude, however, became more and more antagonistic. He had not received instructions to sign the tentative treaty agreed upon in July, and he proposed amendments from time to time which prolonged the negotiations. In October he made it known that he would refuse to sign any treaty. Secretary Hay thereupon notified the Colombian govern-

ment that the President would proceed to close a bargain with Nicaragua if word was not immediately received from Bogotá that Colombia would act. Mr. Concha then received instructions to discuss the proposed treaty. He proposed seven amendments, the chief of which was a provision that the permission by Colombia to transfer the French company's rights should be governed by a special agreement to be entered into between Colombia and the company. This was a plain intimation that Colombia intended to exact from the company an "indemnity" as the price of its consent to the transfer. The United States refused to consider this and the other amendments, and insisted upon the signing of the treaty as agreed upon.

Minister Concha then abruptly broke off negotiations and on November 29, 1902, he left Washington, without taking leave of the State Department or explaining his reasons for departure. The legation was left in charge of Tomás Herran, chargé d'affaires.

Congress was about to convene, and the friends of the Nicaragua route saw their hopes revive. They brought pressure to bear upon the President to close with Nicaragua, in view of the failure to come to terms with Colombia. Secretary Hay was strongly inclined to drop the Colombian negotiations.

Mr. Cromwell, nothing daunted, began conferences with Mr. Herran, who had received instructions from his government to continue the negotiations on the basis of the acceptance by the United States of the Concha amendments, including a provision for the payment to Colombia of $10,000,000 cash and an annuity of $600,000. Minister Hart, at Bogotá, advised Secretary Hay that Colombia intended to demand an indemnity from the French company before ratifying any treaty. Mr. Hay then lost patience, and advised Mr. Cromwell that he would send an ultimatum to Colombia, fixing a time for breaking off all negotiations. At Mr. Cromwell's urgent solicitation Mr. Hay deferred sending in the ultimatum for a few days only. Mr. Cromwell then, after long conferences, induced Mr. Herran to abandon the Concha amendments, and to agree that the amount of money to be paid to Colombia should be determined by arbitration. The United States, however, preferred that a fixed sum should be named, and finally the negotiators agreed to compromise by fixing the amount at $250,000 a year. The treaty was then drawn up as quickly as possible, and on January 22, 1903, at Secretary Hay's residence, it was signed by himself and Mr. Herran. The next day the President transmitted it to the Senate.

Then began a battle over ratification, first in Washington and then in Bogotá.

Mr. Cromwell always found in Senator Morgan a foeman worthy of his steel. The great Alabamian was a determined foe of the Panama route, and he promptly attacked the Hay-Herran treaty. He questioned the power of Vice-President Marroquin of Colombia to conclude any treaty. He questioned Mr. Herran's powers. He offered sixty different amendments to the treaty. He delivered many speeches, and for nearly three months the debate continued. The Democratic caucus agreed to support the Morgan amendments. On March 17, 1903, the treaty was finally ratified exactly as it had been signed.

The option given by the French company was to expire on March 3, but before that date, during the pendency of the treaty in the Senate, an agreement was reached whereby the United States accepted the company's offer, conditioned upon the ratification of the treaty. Official notification to this effect was given on February 17, 1903, by Attorney-General Knox to M. Bô, president of the company.

Instead of proceeding to the ratification of the treaty, Colombia then turned upon the French company and demanded an indemnity of 50,000,000 francs as the price of its consent to the transfer. Secretary Hay was informed by cable on June 2 from the American chargé d'affaires at

Bogotá that "Colombia intends to force the company to make a heavy payment; without which no ratification."

The debate over the Hay-Herran treaty in the Colombian Senate ran from June to August, 1903. A powerful faction demanded the repudiation of the company's extended concession and the forfeiture of the concession in 1906, the date upon which it would have terminated if no extension had been made. The plan was to regain possession of the property and then negotiate a new treaty with the United States, thus giving Colombia the money belonging to the French company. Proposals were made to the United States to agree to modifications of the treaty, but they were rejected. The Colombian congress adjourned on August 12 without ratifying the treaty.

Members of the congress representing Panama had told their colleagues plainly that Panama would rebel if the treaty were not ratified. They reviewed the long negotiations, the deferred hopes of Panama, the throwing away of the opportunity to secure the construction of the canal by the United States, and warned Colombia that the outcome would be secession. The United States government also insisted that Colombia should ratify the treaty according to its agreement.

The Colombian congress met again in October, 1903, and discussed the treaty for a month. Its committees recommended the repudiation of the company's extension. Finally the treaty was referred to the President of Colombia with power to negotiate for modifications; and on November 2 the congress adjourned.

The next day, November 3, 1903, the threatened revolution at Panama occurred. A provisional government was organized and the independence of the isthmian republic was proclaimed. Colombia sent troops to put down the uprising, but the United States gunboat *Nashville* warned the Colombians that they would not be permitted to land. The United States took the position that the treaty of 1846 required the American government to keep open the transit across the isthmus, and that the landing of Colombian troops would interfere with this transit. Thus Colombia's efforts to put down the revolution were thwarted, and the republic of Panama came into existence without bloodshed.

The United States immediately recognized the new government, and received its minister, M. Philippe Bunau-Varilla, who carried powers for the negotiation of a treaty providing for the construction of a canal across the isthmus. The French company cabled to Washington that it was willing to carry out its bargain under the new conditions.

Negotiations were immediately begun by Secretary Hay and Minister Bunau-Varilla, resulting in the conclusion of a treaty on November 18, 1903. The treaty provided that the United States should guarantee the independence of the Republic of Panama, and set forth the terms under which the United States was given exclusive jurisdiction over the Canal Zone and the conditions under which the canal should be constructed.

Naturally, the secession of Panama made a mighty uproar, whose echoes were heard throughout the Americas and in France. Colombia threatened war, and sent Gen. Rafael Reyes to Washington to negotiate a new treaty. The friends of the Nicaragua route raised an outcry. Colombia's charge that the United States government had incited the revolution was reiterated by many Americans. Mr. Cromwell was charged with being the head devil of the plot, although he had been in Paris during that period. M. Bunau-Varilla came in for a scoring. President Roosevelt was especially denounced both in Colombia and the United States. He vigorously replied, as usual, without mincing words, and has ever since maintained that the United States was innocent of all implication in the Panama affair, and that Colombia had been rightly defeated in an attempt to extort excessive sums from the United

States. Mr. Roosevelt's version of this portion of canal history is set forth by himself in another chapter.

Again the Senate took up the canal controversy in considering the Hay-Bunau-Varilla treaty. The debate continued from November, 1903, until February, 1904, when the treaty was approved. Panama promptly ratified the convention, and ratifications were exchanged on February 26, 1904. On April 28, 1904, Congress appropriated the $10,000,000 payable to Panama under the terms of the treaty.

Failing to negotiate a treaty with the United States, Gen. Reyes sailed for Paris, and a suit to enjoin the French company from transferring its property to the United States was instituted by Colombia. This was met by energetic action by the company in hastening the sale. On March 2, 1904, Attorney-General Knox notified the company that the United States was ready to carry out its contract of purchase. Representatives of the United States were sent to Paris, where all legal preliminaries were disposed of. The banking house of J. P. Morgan & Co. was made financial agent in the transaction. The signing of the deeds of transfer of the Panama Canal and the Panama Railroad was effected in the American Embassy, in Paris, on April 16, 1904, in the presence of Ambassador Porter.

On May 4, the delivery of the Panama Canal, the Panama Railroad, and all other property on the isthmus belonging to the company was formally made to Lieut. Mark Brooke, U. S. A., representing the United States. On May 6 all the plans and archives of the company in Paris were delivered to the representatives of the Attorney-General. On May 7 the shares of the Panama Railroad were delivered. The government thereupon handed to J. P. Morgan & Co. a Treasury order for $40,000,000, which was paid in gold coin, transferred to Paris, and paid to the representatives of the French company.

The suits brought by Colombia against the French company came to nought. Several succeeding ministers of Colombia made strong representations to the United States, demanding a settlement of Colombia's claims. Accordingly efforts were made, first by Secretary Hay and later by Secretary Root, to come to terms. Gen. Reyes had been elected President of Colombia, and under his enlightened policy good progress was made. Secretary Root was able to bring about a tripartite arrangement between Colombia and Panama, Colombia and the United States, and Panama and the United States, settling all differences. Treaties were accordingly signed in Washington on January 9, 1909, by Secretary Root, Minister Cortes of Colombia, and Minister Arosemena of Panama. The two treaties to which the United States was a party were ratified by the Senate on March 3, 1909, but Colombia failed to ratify them, and they were abandoned.

When Mr. Knox became Secretary of State he resumed negotiations with Colombia through Minister Du Bois, at Bogotá, but Colombia's demands were still regarded by the United States as excessive, and the two governments failed to agree.

Thaddeus A. Thomson was sent to Bogotá as United States Minister in the summer of 1913. He reopened negotiations with Colombia, under instructions from Mr. Bryan, Secretary of State, and on April 6, 1914, a treaty was concluded between the two governments providing for the payment of $25,000,000 to Colombia. The convention contained an expression of regret on the part of the United States for the occurrences at Panama, which was construed by opponents of the treaty to be equivalent to an admission of wrongdoing on the part of this government. The treaty was bitterly assailed in the Senate and by former President Roosevelt. It was still pending when Congress adjourned on March 4, 1915.

Copies of the treaties herein mentioned are to be found in the Appendix.

CHAPTER XIX

THE COMPLETED CANAL

THE PANAMA CANAL COMPLETE—THE GREATEST LIBERTY MAN EVER TOOK WITH NATURE—232,000,000 CUBIC YARDS TAKEN OUT AND 30,000,000 CUBIC YARDS PUT IN TO COMPLETE THE CANAL—THE LOCK CANAL A SURPRISE TO SEA-LEVEL ADVOCATES AND TO THOSE WHO DECLARED IT COULD NOT BE BUILT—CONGRESS NEVER TURNED AWAY FROM PROJECT AFTER SENATOR HANNA POINTED OUT DANGERS AT NICARAGUA AND APPEALED FOR A CANAL AT PANAMA—FIRST ESTIMATES OF EXCAVATING REQUIRED, FAR TOO SMALL—AMOUNT OF WORK DONE, FAR IN EXCESS OF ESTIMATES MADE—A TRIP THROUGH THE CANAL—THE ATLANTIC APPROACH—THE BREAKWATERS, TERMINUS AND FORTIFICATIONS—THE SEA-LEVEL DITCH—GATUN LOCKS—A GLORIFIED HYDRAULIC ELEVATOR—CARE OF THE LOCKS—A GREAT FRESH-WATER LAKE—DESTROYER OF BARNACLES—THE CULEBRA CUT—THE FIRST STEP DOWNWARD—PEDRO MIGUEL—MIRAFLORES LAKE—END OF THE JOURNEY—THE PACIFIC TERMINUS—THE AMERICAN TOWN—REPAIR FACILITIES—DEFENSES OF NAOS AND HER SISTER ISLANDS—A RETROSPECTIVE VIEW OF THE WATERWAY—ENLARGEMENTS MADE IN LOCKS—CULEBRA CUT DIFFERENT FROM WHAT IT WAS INTENDED—CHANGES AT PEDRO MIGUEL—SOSA HILL UNSATISFACTORY FOR A DAM SITE OR FOR LOCKS—CONCESSIONS TO SAFETY—AN ACCIDENT PROOF, NATURE PROOF CANAL—WELFARE OF THE CANAL ARMY—DEVOTION TO ITS LEADER—THE ART OF REDUCING COST OF LIVING.

THE Panama Canal stands today a completed waterway. Faith in American genius has removed mountains, built an inland sea and made the waters of the land a connecting link uniting the waters of the oceans. The valley has been exalted and the mountain has been made low; the river has gone up to meet the mountain and the mountain has been brought down to meet the river; the meeting point is now the highway between the oceans.

Never before has man essayed such a task. The building of the pyramids, for five thousand years or more the wonder of the world, was play in comparison, and the digging of the Suez Canal appears but a small enterprise. The "Soo" Canal, busiest of the world's great artificial highways, sinks into insignificance when measured by Panama. We fought tropical disease and won a great victory. We fought a rampant river and converted it from a bitter foe into a firm friend. We attacked a mountain; were forced to settle down into a life and death struggle with it; but out of this we emerged thrice a victor. We brought the Atlantic Ocean inland to Gatun, and the Pacific inland to Miraflores, led rivers to do our will, made peninsulas out of islands and lakes out of rivers, justifying in very truth the statement of that citizen of the world, Lord Bryce, to the effect that the Panama Canal is the result of the greatest liberty man ever took with Nature.

The total amount of material handled in the construction of the Panama Canal ranged somewhere around 260,000,000 yards. If this were used to build a wall around the District of Columbia, it would be enough to make that wall sixty feet thick and as high as the Washington monument. If it were piled around the earth at the equator, separating the northern hemisphere from the southern,

it would make a solid wall nine feet high and six feet thick. If it were loaded on Lidgerwood dirt trains such as were used at Panama, it would require 13,000,000 cars, made up into 619,000 trains, to move it, which would make a belt of four dirt trains around the earth. The string of engines required to move such a load, assuming an engine and tender with an over-all length of fifty feet, would be upward of 6,000 miles long—about enough to fill a four track road solidly from New York to Chicago.

We think of the Pyramid of Cheops as one of the wonders of the past and as the one hand-reared structure that has defied the wreck and ruin "of time's remorseless doom" through upward of half a hundred centuries; but the material handled at Panama would make a row of pyramids like Cheops, with base touching base, nearly eleven miles long.

Yet all the wonder is not in the magnitude of the task; much of it lies in the superb audacity of American engineers in facing that task and in overcoming the difficulties it involved. When we started to build the canal there was one class of people who said it would be so easy that we might as well go down to sea-level, and another class who said it would be such a gigantic task that we were foolish to undertake it at all. As we look back over the years gone by since the work began, we see both prophecies unfulfilled and are grateful that neither of them affected the purpose of the United States to build a waterway there. The 32,000,000 cubic yards of slides that went into the canal and delayed the completion of Culebra Cut for two years, fought so relentlessly against the United States that they left no doubt in the minds of those who struggled with and conquered them, that if we had decided to go eighty-five feet deeper, they and not ourselves might at last have been the victors. As will be seen in coming chapters, each foot of depth multiplied the difficulties caused by the slides. The men who said a sea-level canal would not be difficult to build were no worse confounded than the men who said no canal could be built. Some of them saw one specter and some another.

But all the criticisms and fears and prophecies never turned Congress away from the project, from the day when Senator Hanna pointed out the dangers at Nicaragua and appealed to both houses of Congress to face about and to authorize a canal at Panama.

It is interesting to view these things in retrospect and to see how wide many prophecies went of the mark. When the Board of Consulting Engineers made their estimates, they said that 103,000,000 cubic yards of material would have to be removed to make a completed waterway, and while they disagreed as to the type of canal, they all agreed that if a lock canal were built it would take nine years to complete it. Some of those who advocated a sea-level canal said that it would take longer to build the locks of a lock canal than it would require to excavate a sea-level Culebra Cut. How far from the truth this statement was is revealed by the fact that the locks were ready for use a year in advance of the completion of the Culebra Cut down to the eighty-five foot level. And the locks that were thus completed ahead of the Culebra Cut were larger by ten per cent. than the ones about which the statement was made.

To construct a canal in nine years requiring the excavating of 103,000,000 cubic yards of material, contemplated the removal of about a million yards a month. With 232,000,000 yards to excavate, the actual time consumed was seven and a half years, or the removal of an average of approximately 2,600,000 cubic yards a month. Had we taken out an average of only a million cubic yards of material a month, as was provided for in the estimates, we would have taken over nineteen years, instead of seven and a half years, in building the canal. It would have been ready in 1925 instead of 1915.

Let us take a trip in fancy through this

great waterway and see it as it is today before we go into the chapters that tell how it became what it is.

We come down to the isthmus on an almost due south course. As our steamer approaches the canal we first encounter two great breakwaters. The one juts out two miles from Toro Point and is extended to keep the Atlantic terminus protected from the violent northers that sweep down over the Caribbean Sea. On our port side is the second breakwater, which has no land connection. It was built to keep the ocean currents from filling up the Atlantic end of the canal with silt. At the land end of the first breakwater, the fortifications of Toro Point—harmless looking little mounds they appear to us—stand guard with guns that can hurl a ton of steel propelled by a quarter-ton charge of smokeless powder, a distance of fifteen miles or more. On the other side of us are the fortifications of Margarita Island. The hostile fleet that would essay to run through the narrow entrance between the two breakwaters, even if there were no torpedoes to escape after it got through, would be going to certain destruction. For the first few miles, the canal has its banks under water, and we begin to see something of it only when we get in to the shore here, only two or three miles from Gatun. Once inside the breakwater, we go up to the terminal works, built at a cost of many million dollars. Here is where Uncle Sam proposes to make things attractive to the ships of the world; he wants to supply every need they may have and to supply them more cheaply than they can be supplied on any other trade route of the world. There are coal storage basins, where hundreds of thousands of tons of coal are stored; machine shops, where all sorts of repairs may be made and all kinds of spare parts and equipment supplied. There is a bakery, an ice plant, and docks and piers, where cargoes may be unloaded or taken on. Secondary breakwaters are to be found here, which make the anchorage off the line of the canal as still as a mill pond.

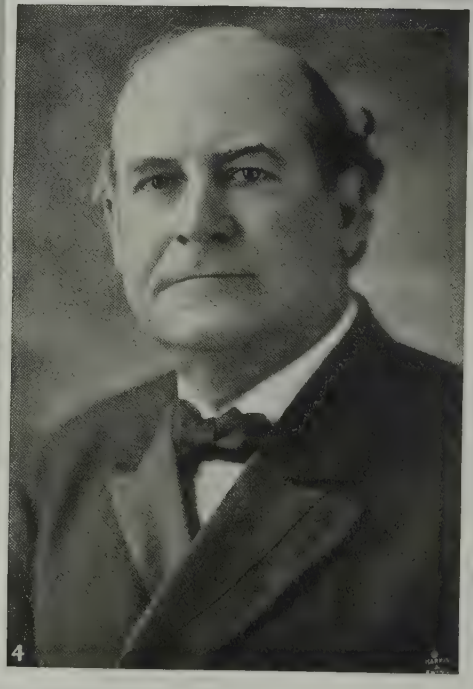
After all matters have been attended to here, from putting off the ship's laundry and taking on its coal; from paying the toll to taking on a pilot, we steer our course inland toward Gatun. First we pass through a swampy country, where the banks of the canal are but little above the water; then we come to the Mindi Hills region, where the canal begins to resemble a Culebra Cut in miniature. From this section we pass through a short level stretch which literally as well as figuratively brings us to the Gates of Gatun. Here we find ourselves at the end of the sea-level channel. Above us, eighty-five feet, there is a fresh water lake, and we must get up into that. Here the locks come into play—a glorified hydraulic elevator that will lift us up. Across our path, however, there stretches a great chain, and our ship must come to a standstill before it reaches this chain.

We draw up alongside a great pier that juts out into the canal channel and await our turn to go through the locks. Presently there come four electric locomotives down the walls of the locks. They make fast to our ship, two at the stem and two at the stern. Held thus in leash, the ship cannot go too fast, nor swing too much from one side of the lock to the other. While the lines from the towing locomotives are being made fast, the big chain that stretched across our path is being let down, the gates of the lower lock are being swung open and everything is made ready for our entrance. Meanwhile, an official of the canal has come aboard. He locks every lever in our engine room so that under no circumstances can one of them be moved while we are in the locks. By this time, the towing locomotives have been made fast; they begin to hum and slowly move us into the first lock. Once in this place, the big gates swing shut after us and up out of the bottom of the lock comes a flood of water. This water gradually raises us a distance of twenty-eight and one-third feet. While we have been lifted the locomotives which pulled us forward



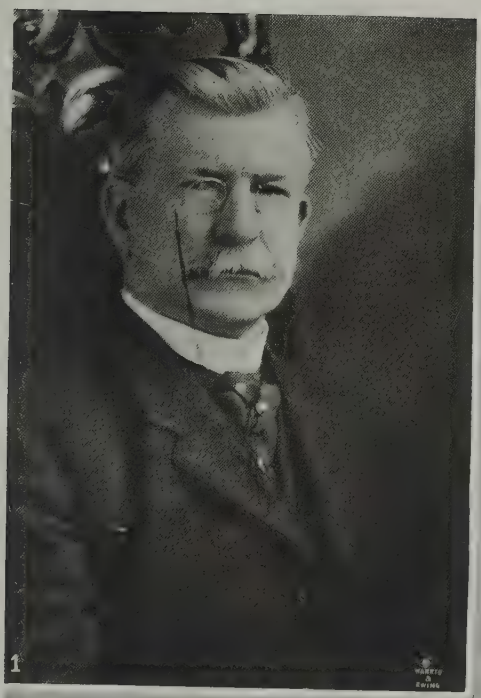


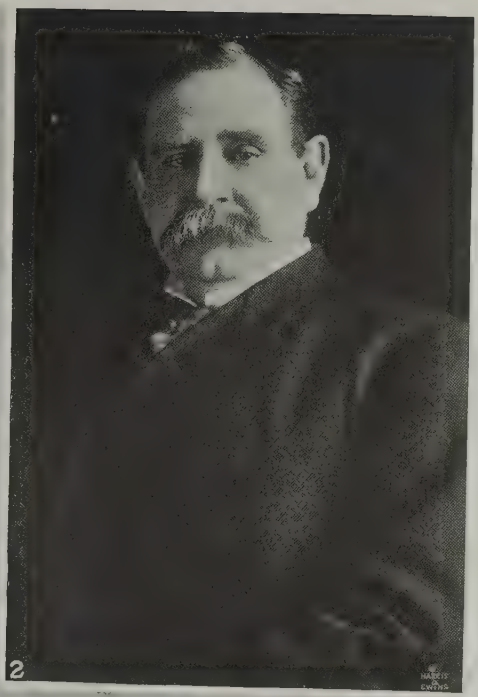




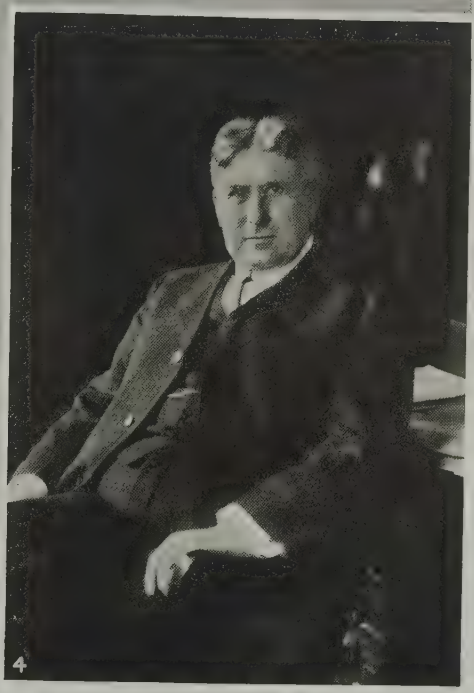
SECRETARIES OF STATE

1. John Hay.
2. Elihu Root.
3. Philander C. Knox.
4. William J. Bryan.









SECRETARIES OF WAR

1. Luke E. Wright.
2. J. M. Dickinson.
3. Henry L. Stimson.
4. Lindley M. Garrison.

to this position have run up an incline to the next level and are ready to pull us up to the place of the next lift. Other gates ahead of us are now opened and we are towed into the second lock. Again the gates are closed behind us, the water is allowed to come in through the bottom of the lock and we slowly rise again a distance of twenty-eight and one-third feet. A third lift of twenty-eight and one-third feet is accomplished in the same manner, and we have reached the level of the lake, eighty-five feet higher than the sea-channel through which we entered. The gates ahead of us are opened, we are towed out to the great center guide wall, the towing locomotives are turned loose, the locks are taken off the levers in our engine room, and we are told to proceed.

Directed by a pilot we take our course through the beautiful Gatun Lake. The lake is so spacious that the ships of the world might congregate there and ride in safety. It is the largest artificial lake in the world. As we sail through it, the barnacles that have adhered to our ship's bottom, carried out of their native salt water, begin to sicken in their new element and one by one to drop off. By the time we have completed our journey of thirty-odd miles through Gatun Lake and Culebra Cut, the bottom of our ship, however foul it may have become, is as clean as if it had just come from a dry dock.

Our journey through the lake continues for twenty-three miles. Near the latter stages, the lake narrows gradually until it takes on the semblance of a canal. The great Culebra Cut is before us. It is a huge gorge with towering banks, cut through the mountain by human hands. Nine miles in length, mighty in proportions, it demands a toll from every traveler, no matter how blasé—a heart toll of admiration for the great digging army that created it. It is here, more than at any other place in the canal, that one can appreciate best the terrific battle waged by man against Nature. We can see signs of the struggle in the sloping sides of the gorge. We pass through this cañon and come to the second set of locks, Pedro Miguel.

At this point we take our first step downward toward the sea. As at the first lock at the entrance to the canal, a giant fender chain stretches across our path. Towing locomotives appear on the extended walls of the locks and are attached to the stem and the stern of our ship. An official of the canal appears also as before, boards the ship, locks every lever in our engine rooms and orders the towing operations to proceed. Meanwhile, the fender chain has been lowered and the upper gates thrown open. We are towed into the lock, the gates are closed behind us and the water begins to pass out through the floor of the lock. Down we go, but slowly, until we find ourselves at the level of the water below the lock, thirty feet lower than the level of Gatun Lake. The gates ahead are opened, and we are towed out into Miraflores Lake.

This body of water is something more than a square mile in area. Across this, a short sail, we come to the gates of the Miraflores locks. There are two locks here, and we are passed through them and find ourselves on the level of the Pacific. We are towed out into the sea-level channel and are ready to commence our eight mile journey to the Pacific Ocean.

We sail out through a low-lying, swampy country, the hills of Agua Dulce on our right, and come presently to a point off Ancon Hill, where the capital of the Canal Zone is located. At Ancon Hill is a modern office building, built of steel and concrete, in which are located the administrative offices of the waterway. Here is the new American town, where the white employees of the canal all live. A little farther along is Balboa, the Pacific terminal, with its great machine shops, its big coaling plant and its modern dry docks. Here are all the facilities for ship repairing that are to be found in any shipyard in the country. According to the scheme of organization at the canal, the Atlantic terminal will furnish the supplies for the shipping world

and the Pacific terminal will provide the facilities for repairs. Any ship that can pass through the canal can be dry docked and repaired at the Balboa terminal.

From this point, passing the cargo handling plant with its docks on our left, we steam out toward the ocean. We pass the 500 acre plot of land reclaimed from the Pacific Ocean and on which are the permanent quarters for the Pacific Coast Artillery. These quarters do not include, however, those of the companies stationed on Naos and her sister islands. Connecting Naos with the mainland is a great embankment that rises out of the sea and whose crest is wide enough for a railway and a roadway. This was built of material hauled down from Culebra Cut and dumped into the shallow bay.

The defenses on Naos and her sister islands are the last word in American armament. Even if there were no mines to encounter within the point, no hostile ship would venture within the blank range of these guns. Here is planted the great sixteen-inch gun built at Watervliet, N. Y., which carries a projectile weighing more than a ton, hurling it for a distance of twenty miles.

The embankment connecting the mainland with the fortified islands, which are themselves connected by stone causeways, serves the double purpose of giving the military forces dry-land connection between the islands and the mainland and of keeping the cross currents of Panama Bay from sweeping millions of cubic yards of silt into the canal.

Having passed through the big waterway, let us take a retrospective view of its construction history. To begin with, the canal that is now a completed waterway is not the canal that we started out to build. We never planned to build locks with a usable length of 1,000 feet and a width of 110 feet. What we did plan were locks with a usable length of 900 feet and a width of 96 feet. Then the Olympic and the Titanic were designed, and President Roosevelt concluded that the locks should be made larger. Congress had authorized him to provide a canal with dimensions sufficient to take care of the largest ships then constructed and in prospect.

The Culebra Cut, also, is different from what was intended. It is 300 feet wide at the bottom, while the original plans called for a cut 200 feet wide at that point. Here again, it was the word of Roosevelt that made the change. He was moved to order it enlarged from the same considerations that led to an increase in the size of the locks. These orders applied only to the increase in the bottom width of Culebra Cut; the vast increase in the top width was not ordered by any one. Nature spoke the word that changed this. At places where the original cut was planned to have a top width of 670 feet, it now has a width of more than a third of a mile. All this meant doubling the task of digging the cut. The great army employed in this work never flinched, however. It showed the world that it could dig two Culebra Cuts in less time and with half as many steam shovels as was thought would be required. Even with such a wonderful showing as this to inspire them, however, the canal diggers were heartily glad they were not asked to sink Culebra Cut to sea level.

At Pedro Miguel, another change was made. It was early decided that ships going through Culebra Cut from the Atlantic to the Pacific might need to wait for lockage at Pedro Miguel; so a basin was constructed at the upper end of Pedro Miguel for this purpose.

Below Pedro Miguel, it was planned originally to build the other Pacific locks at Sosa Hill. It was intended to throw dams across the saddles between the several hills at the Pacific end of the canal and thus make a miniature duplicate of Gatun Lake at the Pacific end. Two conditions changed these plans. Upon more mature examination, it was found that Sosa Hill was a very poor site for a duplicate flight of locks and an equally poor one for a dam. The dam site formed the habit of swallowing up the dam as fast as it was put into

place, and the site was abandoned. From an engineering standpoint, also, the lock site was not satisfactory.

But if Sosa Hill was unsatisfactory as a dam site and as a lock site from the engineering standpoint, it was much more unsatisfactory from a military standpoint. The place stood out close to the open sea, and consequently exposed to bombardment. When this phase of the situation was discussed, all the strategists of the Army and the Navy were unanimous in favor of moving the locks and dams farther inland. Fortunately Miraflores offered a fine position for both the locks and the dam, so that to-day, instead of a large Pacific-side lake, extending from Pedro Miguel to Sosa Hill, there is a sea-level channel from Miraflores to the sea with a small lake between Pedro Miguel and Miraflores.

No other great engineering undertaking ever witnessed so many concessions to safety as the Panama Canal. That it was built for the Government and therefore that he must avoid every chance of failure was kept constantly in mind by the Chief Engineer. No plan for any part of it ever was approved by the chief official until the engineers under him could demonstrate to him that there was no such word as fail in the lexicon of engineering in connection with it. Gatun Dam may have been built much more strongly than was needed to make it safe, but it was considered better to put in five million cubic yards of material too much than ten cubic yards too little. The gates of the locks may have been constructed in a far more substantial manner than seemed to be necessary, but it was preferable to go far beyond the safety point than to come just below it. The facilities for controlling the Chagres River might be great enough to control two rivers instead of one, but it was advisable to provide for the discharge of a hundred million cubic feet a second more than was needed rather than to leave any element of doubt.

The completed canal is a waterway that is as safe as human hands can make anything, and its successful operation as sure as anything in the future may be. The American people may have had fears in the past, but if they had known anything of the determination of the Chief Engineer to eliminate the millionth chance, they would have resigned their fears years ago. It was being constructed for a hundred million people and for generations yet unborn, and "safety" was the pole-star by which the builders shaped their course. The result is that the completed Panama Canal stands to-day as the world's most carefully constructed piece of engineering. There is a margin of safety everywhere that is surprisingly large, but it permits the American people to feel that they have a canal that partakes of the permanence of Nature itself.

Not only is the Panama Canal a stupendous work viewed from an engineering standpoint, but it is unique in the methods of its execution. Never in the history of man was there a greater combination of paternalism and despotism than at Panama. There was paternalism, because the United States did everything for the people; from giving them free rent, free light, free medicine and free amusements, to providing them with government without taxation. There was despotism, because the power of the Chief Engineer, Colonel Goethals, was all sufficient and autocratic. In some respects the Czar of Russia had no more power than this man. The Chairman and Chief Engineer might not have had the power of life or death over his force, but he did have the power of deportation, and he knew how and when to use it. His word was law and there was neither appeal nor repeal.

In building the Panama Canal, the United States wrote a chapter in the art of preventive medicine. It transformed a pest-hole into a healthy community; and while it never went as far as did Great Britain, which completely exterminated the malarial mosquitoes at Ismailia, it did prove that with proper sanitation and proper medical attention, the tropics may

be made as fit an abode for white men as the temperate zones.

A new chapter in the art of reducing the cost of living was also written at Panama. Through the Government commissary, the best western dressed beef was sold to the householder at Panama at prices lower than those in American cities.

What was true of meat prices was true in other lines. With rents, fuel, lights, medicine and medical attention free; with everything the people had to buy marked down to prices which had not been known in the United States in twenty years; and with salaries and wages about fifty per cent. higher than United States standards, the cost of living was never an issue at Panama, except as it was made an issue by those who were unrelenting in their efforts to drive it down still lower.

In view of the triumphant completion of the canal, it is a matter of interest to recall one at least of the many ancient predictions that the wrath of God would follow any attempt to unite the two oceans by an artificial waterway. Among the early travelers through South and Central America after the voyages of Columbus and Ojeda, was Josephus Acosta, a learned Jesuit, of Spain. He wrote much of what he saw and heard, and in the third volume of "Purchas His Pilgrimes," published in 1625, appear the first four "bookes" of Acosta's "Natural and Moral History of the Indies." Among the venerable traveler's observations is the following in regard to the proposal to cut a canal across the Isthmus of Panama:

"They say, that he that first discovered this Sea, was called *Blascowunes* of *Bilbo*, the which he did by that part which we now call *Maine Land*, where it growes narrow and the two Seas approach so neere the one to the other, that there is but seven leagues of distance. . . . Some have discoursed and propounded to cut through this passage of seven leagues, and to joyne one Sea to the other, to make the passage from *Peru* more commodious and easie, for that these eighteen leagues of land betwixt *Nombre de Dios* and *Panama*, is more painefull and chargeable then 2300 by Sea, whereupon some would say, it were a meanes to drowne the Land, one Sea being lower then another. As in times past we find it written, that for the same consideration, they gave over the enterprise to winne the red Sea into *Nile*, in the time of King Sesostris, and since in the Empire of the Othomans. But for my part, I hold such discourses and propositions for vaine, although this inconvenience should not happen, the which I will not hold for assured. I believe there is no humaine power able to beate and breake downe those strong and impenetrable Mountains, which God hath placed betwixt the two Seas, and hath made them most hard Rockes, to withstand the furie of two Seas. And although it were possible to men, yet in my opinion they should fear punishment from heaven, in seeking to correct the workes, which the Creator by his great providence hath ordained and disposed in the framing of this universall world."

CHAPTER XX

THE SANITARY DEPARTMENT

PANAMA'S LESSON TO THE WORLD—A DEATH-RATE SPLIT IN TWO—LIBERALITY OF EXPENDITURES—THIS LIBERALITY JUSTIFIED—SUCCESS IN PORTO RICO AND ELSEWHERE—DR. GORGAS APPOINTED—HIS EXPERIENCES IN CUBA—HANDICAPPED AT FIRST—THE MOSQUITO GETS HIS CASE REOPENED—MAGOON TO GORGAS'S RESCUE—SLEUTHING FOR MOSQUITOES—GOETHALS AND GORGAS—GETTING RID OF YELLOW FEVER AND MALARIA—OIL ON MOSQUITO-TROUBLED WATERS—THE ISTHMIAN QUARANTINE—VACCINATING INCOMING PASSENGERS—FREE HOSPITALS—THE TABOGA SANITARIUM—THE SPIRITUAL HEALTH OF THE PEOPLE—WORTH MANY TIMES ITS COST—ARMY SURGEONS SUCCESSFUL EVERYWHERE.

THE story of the sanitation of the Canal Zone constitutes one of the most dramatic examples that the world affords of what medical science can accomplish when properly backed by a government. With the eyes of the world focused upon the big undertaking, there was that degree of the spectacular in the work that is required to command universal attention, and so it has come to pass that one of the greatest benefits that the Panama Canal will bring to the people of the earth is the splendid lesson it has taught humanity—the lesson that contagious or infectious disease may be controlled and held in check.

To any one who has visited the Canal Zone, no statistics are necessary to show what has been, and what may be, accomplished by sanitation. His own eyes tell him of the wonderful transformation that has taken place, as he travels across the isthmus and sees where thousands of mosquito paradises have been transformed into disease-free spots. He looks from the vantage point of an observation car at the fifty-mile parkway across the isthmus. But to others, it need only be said that the death rate for the population of Panama, Colon and in the Canal Zone has been cut down from the forty-two per thousand that obtained when the Americans went to Panama to the twenty-two per thousand that existed when the canal became a completed waterway. Apply that wonderful decline to our own country and see what results: If our growth as a nation has been normal since 1910, our present population must approximate a hundred million souls. A saving of twenty lives per thousand would mean to us the saving of 2,000,000 lives a year, and a saving of at least 5,000,000 cases of sickness. There is the measure of what has been accomplished at Panama.

The wonderful liberality with which the United States provided for health purposes on the isthmus is revealed by the fact that nearly $20,000,000 was appropriated for carrying forward that work during the ten years of the construction period—which appropriations covered the hospitals, medical attendance, sanitation and other activities. Of this about $4,000,000 went to sanitation proper. Now, when we remember that the population of the Canal Zone was only 62,000 and that the area of that part of the Zone under active sanitary control amounts to only 1,200 acres, it will be understood that there was no lack of funds with which to prosecute the work. It is not to be presumed, however, that the entire Canal Zone has been cleaned up and converted from an untamed jungle into a place fit for the residence of men; as a matter of fact, except for the 1,200 acres in the settlements along the canal and the few little clearings made by negroes for

their tiny yam patches, all of the 278,000 acres of the Canal Zone's area lie outside of the sanitary district.

When we come to look elsewhere we find that equally brilliant results were accomplished with the expenditure of very much less money. That is true of Porto Rico. When the Americans took possession of that island the death rate was practically the same as the death rate at Panama when we took over the canal strip. To-day the death rate in Porto Rico is just as low as it is at Panama, notwithstanding the fact that Porto Rico is the most densely populated island on earth. The same density per square mile, if applied to the United States, would give us a population of nearly a billion. Dr. Bailey K. Ashford, who cleaned up Porto Rico, had only a small percentage of the funds per capita or per acre at his disposal that Colonel Gorgas had at Panama. But in Porto Rico they could afford to count the cost. There was not a great international project at stake, nor would the world have suffered from failure in that country as it would have suffered from disaster at Panama.

When the United States started in to build the Panama Canal, all eyes turned to Dr. William Crawford Gorgas, then a surgeon in the United States Army with the rank of major, as the man of all men best fitted to take charge of the work of sanitation. He was fresh from his successes in Cuba, where he had, under General Leonard Wood, applied the lessons of sanitation that had been learned by Dr. Walter Reed and his associates in their remarkable series of experiments with yellow fever. Although he had gone into the work of ridding Havana of yellow fever with a skepticism that he afterward admitted, he had carried it to a highly successful conclusion. As late as 1902 he stated that he had doubted the conclusion of Reed that yellow fever was caused only by mosquitoes, adding that he had not believed it was even the ordinary, much less the only cause.

But his own work proved a cure for his skepticism, and from that day to this he has stood out as the world's most famous master of tropical sanitation. He went to Panama with the first forces that steered their course that way after the American occupation. He laid out his sanitary campaign in the utmost detail, in which he was assisted by a number of experienced surgeons, as well as by Major Roland Ross, the man who had proven the mosquito theory of the causation of malaria, and upon whose work Reed and his associates builded in making out their case against the yellow fever mosquito.

Dr. Gorgas returned to the States for a few months, and then went back to his work of cleaning up the isthmus. From the first he was handicapped. A commission of seven men of equal authority never was known to do things promptly under any circumstances; and when it came to a commission, a part of whose members were in Washington and another part in Panama, it was worse than ever—so that more money came to be spent on telegraph and cable tolls than was spent on sanitation. But Colonel Gorgas was a patient man; and though Major General George W. Davis, then Governor of the Zone, and managing commissioner, was somewhat out of sympathy with him, he did the best he could and hoped the day would come when he could do better. Finally General Davis was relieved, and Gorgas was made acting governor and given temporary free rein.

Chief Engineer Wallace was somewhat distrustful of Gorgas's ability to control yellow fever, and at one time Mr. Taft seemed to hold the same opinion. But when Charles E. Magoon became Governor of the Canal Zone, he told Colonel Gorgas that he wanted him to understand that all the resources of the Canal Commission were behind him. With this inspiriting assurance, Colonel Gorgas set out to undo the damage that had been done. Stegomyia had been tried and convicted in Cuba, but had moved for a new trial in Panama and had obtained it. With the outbreak of the epidemic of 1904-5 some of the people settled down to the conviction that

the mosquito was not responsible for the yellow fever; many of them went so far as to tear the screens off their windows as a protest against the theory. Every ship that left the isthmus carried a full passenger list, and those who had to remain behind were under daily fear of contagion.

But Governor Magoon changed things. The chiefs of divisions were held responsible for the keeping of the doors and windows of the rooms of their employees properly screened. Guards were stationed around to see that screening orders were obeyed and office doors kept closed. Wherever there was a case of yellow fever the antecedents of the patient were investigated with extreme care. Here was a man who was registered at a Panama Hotel. He was sick and some one feared he had yellow fever. When the authorities came to look him up, he had disappeared. The next day he was found in the streets intoxicated and suffering from yellow fever. He was taken to the hospital, where he died. Then they looked for his associates. Nobody seemed to know him. Finally it was heard that some of his countrymen frequented a certain bar room. Here again no one knew him, but several of them had heard him talking with an Italian. The Italians of the entire City of Panama were canvassed, and at last the man who had talked with him was found, but the man knew him only slightly. However, he did know that the man was acquainted with the watchman at a certain little theater. This watchman was hunted down and was found to be ill with yellow fever himself. Then a little girl who frequented the theater was found to have taken the disease. Every case was thus rigidly investigated and all sources of infection run down. The result was that the last case of yellow fever was stamped out in the early part of 1906, and a second and final decision was rendered against the mosquito, this time in the court of last resort—a decision which the world owes to the energetic measures of Colonel Gorgas, and the support of Gov. Magoon.

From that day forward Colonel Gorgas enjoyed the confidence of the world and of the canal engineers alike. In more recent years there was up some feeling between the partisans of Colonel Goethals and those of Colonel Gorgas. Acting upon the order of President Taft that the actual work of digging ditches, cutting grass, and the like, should be placed in the hands of the Quartermaster's Department, under the supervision of the Sanitary Department, Colonel Goethals directed that this course be pursued. It resulted in no loss of sanitary efficiency, and in a considerable saving of money. But the friends of Colonel Gorgas always felt that Colonel Goethals was responsible for the order, whereas it was issued at the direction of the President himself and in spite of Colonel Goethals's views in the matter. Colonel Goethals never has failed to commend the excellence of the sanitary work at Panama, upon all proper occasions.

The first work of protecting the health of the people of the Canal Zone always had been that of holding the mosquito in check, for malaria and yellow fever had to be controlled—the one kept down and the other kept out, if the sanitary work was to be successful. There are upward of a hundred species of mosquitoes on the isthmus, but only the *anopheles* and the *stegomyia* families have evil reputations.

The habits of the mosquitoes lend themselves easily to the needs of man in his war of extermination against them. They lay their eggs in the water, and when their larvæ hatch out, they must come to the surface for a breath of air. By spreading oil upon the surface of standing water the larvæ are destroyed.

Numerous methods of "pouring oil on the troubled waters" have been in use at Panama. One of the favorite methods is to put a wick in a piece of pipe soldered into a large ash can. The can is filled with oil and set on a board that spans the little stream let it is meant to protect. Drop by drop the oil in the can passes down and along with the waters, and when they reach quiet

levels there is a scum of oil over the placid surface of the water from bank to bank. Another method of applying the oil is to strap a spraying tank filled with it upon the back of a husky negro and then send him forth to "nose out" all little pools of stagnant water in the neighborhood and to cover them with a film of oil. In these ways about 700,000 gallons of oil and 124,000 gallons of larvicide were used annually.

But with all that, there were still breeding places that could not be found, so it was necessary to keep down the grass and brush, to the extent of about twenty million square yards of the former and about half as much of the latter every year. And then some two million feet of ditches had to be kept clean and about a quarter of a million feet of new ones dug for drainage purposes.

Yet with all of this war against the mosquitoes, a few of them still managed to perpetuate their species, and this required the expenditure of about a million dollars for screens for shutting them out of the houses. Even then some few would manage to get inside, and these were either caught in traps or killed. About a quarter of a million malarial adult mosquitoes were so destroyed.

While the quarantine on the Canal Zone was a very rigid one, it did not include malaria in the list of diseases to be excluded. But for those diseases which were banned it was as unrelenting as fate.

Shortly after the United States began operations on the Canal Zone a ship load of deck passengers from Martinique was brought over. When it was announced that they had to be vaccinated, one of their number, a voodoo doctor, led a mutiny against inoculation, in which a hundred and fifty took part. He pronounced it an attempt to put "the inextinguishable mark" upon them, so that they could never escape from the isthmus. They declared they would rather suffer martyrdom aboard than to be held captive ashore, and it was only after three days of unsuccessful parleying that the mutiny was broken up by their being driven ashore by the police. Still protesting, they were rounded up, in spite of their efforts to escape, vaccinated, and the next day sent to work.

A quarantine station was maintained at each end of the canal, and will be continued under the permanent organization. Every ship arriving was boarded, and if a clean bill of health could be presented, nothing remained to be done except for every passenger and member of the crew to be examined for quarantinable disease. But if the ship had come from an infected port there was trouble—all passengers went to the quarantine station until it was safe to pass them through the lines.

The government furnished all of its employees with free medicines, free medical attendance, and free hospital and burial services. It dispensed about a ton of quinine a year, provided camps where the laborers who were not ill enough to go to the hospital could rest and be treated, and ran one or two hospital cars on every passenger train that crossed the isthmus.

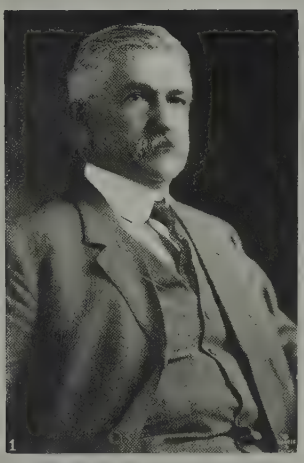
The hospitals maintained were by far the best to be found anywhere in the tropics. The one at Ancon is very large, perfectly appointed, and situated in attractive grounds. It is a monument to the Catholic sisters who conducted the institution and beautified the grounds under the French régime. The hospitals had an average of about 600 whites and 1,200 negroes as patients, and during each year there were admitted and discharged some 18,000 whites and 14,000 negroes. About 5,000 whites and 11,000 negroes were treated annually in the sick camps. The total number sick in hospitals, camps, and quarters in 1913 was 48,000. Applications to the dispensaries for treatment amounted to 311,000 among the whites in 1912 and 322,000 among the colored employees.

A modern sanitarium was maintained at Taboga, where the white employees who had passed through the hospitals were sent to recuperate. The number of white employees on the sick list ranged around forty





1. Gorgona as it was during construction days ; today its site is under water.
2. View from grounds of Taboga Island Sanitarium, where American invalids were sent to recuperate.











GOETHALS'S CHIEF AIDS

1. Maj. Gen. Wm. C. Gorgas
2. Brig. Gen. Harry F. Hodges
3. Brig. Gen. Wm. L. Sibert
4. Rear Admiral H. H. Rousseau
5. Lt. Col. D. D. Gaillard

per thousand, while the number of colored employees averaged around seventeen per thousand, in spite of the fact that the death rate among the colored people was higher. The cost of operating all the hospitals, sick camps, and dispensaries of the Sanitary Department amounted to $739,000 in 1912, at an average cost of $1.22 per day in the hospitals and forty-seven cents in the sick camps.

The Sanitary Department not only looked after the physical health of the people, but after their spiritual health as well. The churches were under its jurisdiction and it carried some fifteen ministers of the gospel on its pay rolls. It also took care of the cemeteries and conducted the undertaking and embalming business required for the canal army.

Looking over the history of sanitation on the Canal Zone, it must be pronounced a wonderful record. Any careful analysis of the figures of expenditures of the Sanitary Department must show that the work was expensive, that it cost perhaps more, result for result, than sanitation anywhere else in the world. But that does not detract from the fact that it was successful, and that it was worth far more to the United States than its cost. Carrying with it that degree of publicity that enabled it to arrest the attention of the world, it ever will stand out as the creating force of a world-wide movement in the direction of better sanitation. And in that way it has done more for the health movement that is sweeping over the world than any other single agency in the history of man.

The success of the American army surgeon has been universal, whether his work is at Panama, in Porto Rico, in the Philippines, or at home. There is glory enough for them all, and if the successful work at Panama serves to awaken the American people to a knowledge of the fact that they have medical triumphs to be proud of wherever the American army surgeon has gone, its benefits will extend far beyond the limits of the Canal Zone.

The experience in sanitation at Panama in its application to the quarantine of the world's trade routes is graphically presented in a later chapter in this volume by Dr. Rupert Blue, Surgeon-General of the United States Public Health Service.

CHAPTER XXI

THE CANAL UNDER WALLACE

THE NEGLECTED BEGINNING—TAKING OVER THE FRENCH PROPERTY—"UNSCRAMBLING" THE CHAOS OF THE HOUR—EXCELLENCE OF THE FRENCH EQUIPMENT—VALUE OF THE FRENCH PROPERTY—THE FIRST CANAL COMMISSION—ITS TRIP TO THE ISTHMUS—MORE INFORMATION NEEDED—SETTING UP THE CANAL ZONE GOVERNMENT—WALLACE APPOINTED CHIEF ENGINEER—"MAKING THE DIRT FLY"—AT CROSS PURPOSES—ANNOYING RED TAPE—UNSATISFACTORY CONDITIONS—GETTING RID OF THE COMMISSION—THE NEW BOARD—WALLACE SEEMINGLY SATISFIED—HIS RETIREMENT, AND THE REASONS THEREFOR—GOETHALS' JUST AND GENEROUS VERDICT.

WHEN one comes to write the story of a great project successfully carried to completion there is temptation to pass by that era of unsightly chaos which marks the laying of the foundations and to begin with the completed undertaking and the days when it began to take shape.

And so it has been with every historian of the Panama Canal. The administration of John F. Wallace is passed over lightly, and that of John F. Stevens is given but little more attention. And yet the work that was done by these men was so essential to the ultimate success of the canal, and the steps then taken so illuminative of what was required for the triumph of the American canal diggers, that he who would know and appreciate the full story of the construction of the big waterway must go back further than the Goethals administration.

It was on the morning of the 4th of May, 1904, that, the formalities of the sale of the French property to the United States having been perfected, Lieutenant Mark Brooke, of the United States Army, took possession of this property. There was comparatively little ceremony about it, but the keys were delivered, and immediately the work of getting under way was begun. The first step was to reëngage all the employees of the New Panama Canal Company and continue the work just as it had been going on. This did not mean a great deal, for the French company was merely keeping enough men at work to justify its title to the concession.

The next step was to begin the work of "unscrambling" the chaotic pile of French property that had been acquired. From one side of the isthmus to the other there was an almost unbroken row of houses and machinery, material and junk, and to extricate all this and classify it was a task whose proportions were enhanced by the wreck and ruin and tropic growth of some fifteen years. The railroad was a mere spectre of rust and decay, running through a fifty-mile cañon of tropical jungle. The rolling stock had degenerated, and even the steamship line had become a byword up and down the Spanish Main.

There were 2,148 French buildings acquired, many of them standing out in the jungle and infested by all sorts of tropical pests. The force that was to prepare the isthmus for the canal diggers had to occupy these houses until new ones could be built, and it was nearly impossible to make many of them habitable.

The best machinery and supplies had been gathered into several great parks and storehouses, and the rolling stock in the main had been kept well painted, the same being true of the floating equipment. It took many weeks to card-index the French equipment so that it could be found when needed, but the results amply justified the trouble. For whatever the French did on

the isthmus was done well. Tiny Belgian locomotives bustled over the works as if they were fresh from the factory instead of rehabilitated mechanical waifs which had been exposed to the rust and ruin of fifteen rainy seasons. With a new cab to replace one that had rotted away, with a new pipe here and a new piece of brass there, they hustled around, handling concrete trains as proudly as though they were strong Baldwins drawing the huge dirt trains to the dumps.

What was found to be true of the engines was equally true of the dredges and other floating equipment. When we compare it with our canal-digging equipment of a quarter of a century ago, it becomes evident that the very latest word in excavating machinery that had been spoken at that time was incorporated in the French equipment at Panama.

Much was said at the time of the acquisition of the property of the New Panama Canal Company to the effect that the United States had paid too much for it. This statement has been amply disproven by experience and by more recent inventories of what actually was acquired. To begin with, the profits of the Panama Railroad operations have been large enough to amortize the entire outlay made on its account. The usable excavations of the French were worth $25,000,000; maps, drawings, and records, $2,000,000; lands, Pacific ship channel, and roads, $1,750,000; and the Panama Railroad, upward of $9,500,000. According to a careful estimate in 1911, the total value of the property amounted to nearly $43,000,000.

The first Isthmian Canal Commission appointed for the building of the canal, in accordance with the terms of the Spooner law, under which the waterway has been built, was composed of Rear Admiral John G. Walker, Major General George W. Davis, William Barclay Parsons, William H. Burr, Benjamin M. Harrod, Carl E. Grunsky and Frank J. Hecker. In appointing them President Roosevelt declared that "What this nation will insist upon is that results be achieved."

The commission arrived on the isthmus on April 5, 1904, and after three weeks of study of the problems to be met, decided that they needed more information than the French records disclosed. So they returned to the States and began to organize surveying parties. Meanwhile Major William C. Gorgas, fresh from his sanitation successes in Cuba, after accompanying the Commission to the isthmus, at the direction of President Roosevelt, was engaged in drafting the plans of the sanitary campaign that was to clean up the isthmus and make it habitable for the canal-digging army soon to invade that territory.

When the surveying parties returned to the isthmus they had to go out into the jungle, and supplies were so scarce that they were compelled to live almost like aborigines. The only way they could get fresh meat was to kill monkeys, and some of them declared that the outlines of a skinned monkey so closely resembled those of a baby that monkey meat did not make a very delectable dish.

Major General Davis and Colonel Gorgas returned to the isthmus with the surveying parties, and the former set out to organize the civil government of the Canal Zone. He first issued a proclamation announcing his assumption of the Governorship of the Canal Zone, and then negotiated an agreement with the Panaman Government concerning the relations that would have to exist between them. He then created the Sanitary Department and set Colonel Gorgas to work carrying out his plans.

John Findley Wallace was elected chief engineer of the canal, May 6, and assumed the duties of the office June 1, 1904. He arrived on the isthmus the last of that month. His first undertaking was to get the equipment already on the isthmus into shape. The insistent demand that the chief engineer "make the dirt fly" was heard by him and heeded, and by equipping the machine shops he was able to repair about five or six of the French locomotives

a month and about a hundred French dump cars, sending them to Culebra Cut at once. It was his intention also to install a new American steam shovel, with its equipment of three locomotives and a hundred big cars, every week.

But it was not long until Mr. Wallace was at cross purposes with his commission. With an auditing system in Washington that made it next to impossible to get action, he found himself so handicapped that it was but natural that he should have become impatient. Up to August 1, 1904, Major General Davis was the managing representative of the Commission on the isthmus, and Mr. Wallace was under his immediate direction. At that date General Davis was relieved of the duties of managing director, and the chief engineer was directed to report to and receive orders from the Chairman of the Commission. Something of the feeling that existed between Wallace and the Commission crops out in the annual report of the Commission for 1904, in which it was somewhat sarcastically stated that "while the orders give the chief engineer entire independence as respecting the resident member of the Commission, he is required to furnish the said member with copies of his reports to the chairman. Up to the present time, October 1, no such reports have been received, but this circumstance is perhaps due to the fact that Mr. Wallace has been absent from the isthmus since Sept. 14th."

Under the cumbersome administrative machinery then provided, coupled with the internal dissensions of the Commission, Mr. Wallace and Colonel Gorgas were in the plight of the little girl who obtained her mother's consent to go in to swim, but who was, in the same breath, forbidden to go near the water. They were authorized to clean up the Canal Zone and Panama and Colon, and to construct the necessary waterworks and sewers in the terminal cities, but delay and red tape met them at every turn. They might have had the water turned on in Panama six months sooner if they had been given proper support. Colonel Gorgas begged for screen wire to shut out the mosquitoes, but he might as well have kept silent. In disgust Wallace declared that red tape was "system gone to seed." He said a child could break a single hemp fiber, but that many strands woven together would hold in leash the biggest ship that floats; and that by the same token enough red tape could prevent the building of the Panama Canal. He concluded that it would take infinitely longer to build a lock canal under such a system than to build a sea-level canal under contract.

Under these conditions, the situation on the isthmus was most unsatisfactory during the latter part of 1904. There were no acceptable quarters, no suitable food supplies, and no attempt to make conditions attractive. But for the high wages the white employees would have left.

At this juncture Mr. Wallace visited Washington. The result of his visit was that the Commission was asked to resign and a new one was appointed. President Roosevelt called the attention of Congress to the fact that building a canal with a seven-member commission was a failure and asked that it be reduced to five, or, preferably, to three. The House granted his request, but the Senate ignored it.

The result was that Mr. Roosevelt decided to take one of his famous short cuts around a legislative obstacle. He created an executive committee of three members of the second commission, with powers almost coextensive with those of the entire body—the other members having few other duties than to agree to what the executive committee did. The Commission consisted of Theodore P. Shonts, chairman; Charles E. Magoon, governor of the Canal Zone; John F. Wallace, chief engineer; Mordecai T. Endicott, Peter C. Hains, Oswald H. Ernst, and Benjamin M. Harrod. At the same time the Panama Railroad was reorganized, and placed under the virtual control of the chief engineer. Under the new arrangement Mr. Wallace seemed to have obtained all the authority he

needed. He returned to the isthmus, content with the revised organization, arriving there June 2. An epidemic of yellow fever was raging, and the wife of his secretary had died. Six days later he cabled for permission to return to the States. Governor Magoon, it is said, privately cabled to Secretary Taft that Mr. Wallace thought he had a slight attack of yellow fever, and that this, coupled with the prospect of a better salary, was responsible for his desire to return home. Secretary Taft granted his request. Mr. Wallace prepared to leave, and when the canal force learned what was transpiring a rush for shipboard followed. It looked as if nothing could prevent a yellow fever panic.

When Mr. Wallace told Secretary Taft of his disgust with red tape, of his promise to his family to consider well before accepting a permanent residence on the isthmus, and of his prospective employment in a better-paying position, Mr. Taft was furious. He ordered Mr. Wallace to present his resignation at once, and it was immediately accepted. In a later chapter of this work the reader will find Mr. Wallace's own story of his experience on the canal.

It seems, at this distance, and with Mr. Wallace's statement to a congressional committee before us, that the conditions that led up to his resignation were cumulative. That he was afraid of yellow fever, as was his family, he himself admitted. That he was disgusted with red tape hindrances he frequently declared, both before and after his resignation; that he found a better engagement in New York an attraction under these conditions needs only to be stated to be believed. But it is probable that greater than all these reasons was his conclusion that service under Chairman Shonts, to whom the President had promised a "free rein," would not be conducive to success.

The retirement of Mr. Wallace was a blow to the work, undeniably. It came at a critical time in the history of the canal; and it came in a way that demoralized the force on the isthmus and shook public confidence at home. But it was, under the circumstances, the natural result of trying to execute a complex undertaking under a mistaken plan of divided authority.

It may be best to take the estimate of the situation that confronted both Wallace and Stevens, as expressed by their successor, Colonel Goethals. "I think," said he, "that either of these engineers might have built the canal had he been given a free rein. They had been engaged in a field where all that was asked of them was results. They laid out their plans, submitted them to their boards of directors, with the accompanying estimates of cost, and then were told to go ahead. They went ahead, responsible only for the final result, and that result was satisfactory. They never knew anything of the irksomeness of red tape, had no patience with interference by the Commission and by the Government. They were men whose whole training had fitted them for exercising a 'free rein' and had unfitted them for the hampering restrictions of red tape.

"Army men are familiar from their youth with other conditions. They know that it is their duty to adjust themselves to the doing of things in the way their Government directs, and it is their acquiescence that makes possible successful work by them. That is why the army succeeded."

CHAPTER XXII

THE STEVENS RÉGIME

JNO. F. STEVENS APPOINTED CHIEF ENGINEER—AROUSING CONFIDENCE IN THE DISCOURAGED FORCE—YELLOW FEVER, MALARIA, AND COLD FEET—A COLLISION HAS ITS MERITS—STEVENS AND HIS HEAD CARPENTER—PICKING HIS ENGINEERS—CLEANING UP PANAMA AND COLON—BUILDING QUARTERS AND PROVIDING CLUB HOUSES—RECRUITING THE CANAL ARMY—THE INDIFFERENT WEST INDIAN NEGRO—THE CHIEF ENGINEER'S HANDICAPS—ARRANGING PLACES FOR DUMPING SOIL—BOARD OF CONSULTING ENGINEERS—THE MARKELL FEEDING CONTRACT—THE EIGHT-HOUR LAW AND CIVIL SERVICE—STEVENS AND SHONTS AT ODDS—THE RESIGNATION OF MR. STEVENS—THE PROPOSAL TO BUILD THE CANAL UNDER CONTRACT—DIFFICULTIES IMPOSED BY THE RAINY SEASON—GOETHALS CARRIES FORWARD THE PLANS OF HIS PREDECESSOR.

THE selection of Jno. F. Stevens to succeed John F. Wallace as chief engineer of the Isthmian Canal Commission was announced within a day or two after Mr. Wallace resigned. Mr. Stevens was to be paid $30,000 a year. He was on the eve of accepting a contract to go to the Philippines to build the Government railroads there. His determination to accept the isthmian berth instead of going to the Philippines was reached at the personal solicitation of President Roosevelt.

When Mr. Stevens arrived on the isthmus, July 26, 1905, he asked the Canal Commission to permit him to suspend work on the excavations in Culebra Cut in order that he might perfect the tranportation facilities needed there. His first effort was to infuse confidence into the dispirited canal army. He had a knack of saying and doing things that pleased the canal employees. He promptly told the people that there were three diseases on the isthmus—yellow fever, malaria, and "cold feet," and that the greatest of these was "cold feet."

In reporting on conditions as he found them on the Panama Railroad, he said that the world had moved and that the Panama Railroad had not, in personnel, equipment, methods, or otherwise. All efforts practically had ceased to remedy the congestion of freight. "About the only claim for good work," said Mr. Stevens, "that I have heard made, was that there had been no collision for some time. But even a collision has its good points as well as bad points—it indicates that there is something moving on the railroad."

On one occasion the chief engineer sent his head carpenter to Gorgona to build certain sheds on the site subsequently occupied by the machine shops. The carpenter found the proposed site covered with old burnt equipment. He wrote to Mr. Stevens for instructions as to how to proceed under these conditions, and received this prompt reply: "Wait until I have a free Sunday, and I will come down and move the material for you."

Mr. Stevens was a ubiquitous man on the isthmus during those days. He went out over the line in overalls every day, and at no time did he allow any of the work to escape his attention. It was not long before he had secured a strong force of engineers, a large number of whom stayed with the work until it was completed.

There were many things to be done in reducing the chaos that existed on the isthmus, and in preparing for the great work that was ahead. Comparatively

little had been done in the direction of cleaning up Panama and Colon. Under the treaty with the Republic of Panama, the United States was to build modern water and sewerage systems for the cities of Panama and Colon, and was to be reimbursed for this work by collections from the sale of water. In this way about two and a half million dollars was spent, and this debt is being gradually amortized by the water rent collections. These cities had been pest holes of disease, with a supply of drinking water brought in barrels from springs of questionable character, and with no sewerage facilities whatever. Under the ministrations of the United States Government they were abundantly supplied with hydrant water, sewerage systems were provided, and their streets, though still narrow, were well paved. The transformation was such as to be almost beyond belief. The story can be told in no other way so graphically as by contrasting pictures of Panama streets before and after the sanitary campaign.

Another problem facing the chief engineer was that of providing suitable quarters for the men who were to dig the canal. The buildings which had been acquired with the French purchase were all remodeled, and hundreds of others were built. In addition to this the Y. M. C. A. club houses had to be completed, and many other important structures planned and equipped. During the first year and a half of his administration, Mr. Stevens spent $30,000,000. Of this, $5,000,000 was for governing and sanitation, $7,000,000 for quarters, and $12,000,000 for supplies.

Mr. Stevens then undertook the task of recruiting an adequate force for the building of the canal. This was perhaps the hardest task of all. Panama had made a highly unsavory reputation in the labor markets of the world. Recruiting agents were sent to the West Indies, to Italy, and to Spain. It was not long before these agents were sending a steady stream of West Indian laborers to the canal. By making certain concessions in the way of guarantees, the consent of the Spanish Government was obtained for the departure of its laborers for Panama.

When the work got under way it was found that the West Indian laborer was a rather lazy, indifferent individual. Mr. Stevens once likened him to a Japanese flagman he had employed on the Great Northern Railroad. This flagman was sent back to stop oncoming trains, but permitted an engine to run by him without flagging it, thus precipitating one of the most serious wrecks in the history of the road. When asked why he had not flagged the engine, he replied that his orders were to flag trains. So it was with the West Indian laborer: he carried out orders literally, and very slowly. The chief engineer found that one white man was worth three negroes in the digging of the Panama Canal. When Mr. Stevens established the wage scale that continued to the day of the completion of the canal, he granted twenty cents an hour for unskilled white labor, and ten cents an hour for negro labor. The negro laborer was inclined to resent this seeming discrimination against him, but he continued to improve to the end, and finally was able to render good service for the money paid him.

The red tape which had bound the hands of Chief Engineer Wallace was almost as vexing to Chief Engineer Stevens. He found a tendency everywhere to postpone action, and sometimes he went forward on his own responsibility. This policy soon began to show results. He laid new railroad tracks through the Culebra Cut. Where there were little old French dump cars in use, no two of which had trucks of the same gauge, and some of which even had trucks of different gauge, the dirt trains were now made up of up-to-date Lidgerwood and Western dump cars. Where drilling for blasting had been done with individual plants, and by the old and expensive method of hand drilling, a compressed air system was installed, and the efficiency of the drilling force immensely increased.

Indifferent judgment had been shown

in the selection of sites for dumping material, and in laying them out. It became necessary to select new dumps, and to lay out those already established in such a way that trains could be unloaded in the shortest possible time. By the time Mr. Stevens had been on the ground a year he had perfected a system of transportation and spoil disposal which was good enough and broad enough to last to the end of the construction period, with only the extensions that the operations called for. When it is remembered that over 100,000,000 cubic yards of material had to be disposed of on these dumps, it will be seen how necessary it was that they should be properly laid out.

While Chief Engineer Stevens was at work on the plans for the successful attack against the isthmian barriers, he was also engaged in gathering data upon which could be predicated a judgment as to the type of the canal that should be constructed, and as to the probable unit costs which its construction would involve. President Roosevelt, in the latter part of 1905, sent a board of consulting engineers to the isthmus with instructions to consider the question of the relative merits of a lock canal and a sea-level canal, the cost of the two projects to be taken into account, as well as the time within which either could be completed.

This commission voted eight to five in favor of a sea-level canal. Chief Engineer Stevens did not agree with its conclusions, nor did any of the members of the Isthmian Canal Commission, except Rear-Admiral Endicott. When President Roosevelt read the statement of Chief Engineer Stevens, in which he favored a lock canal, the President became a convert from the sea-level type, and ordered work on the isthmus to move forward with a view to constructing a lock canal. This decision afterward was ratified by the Senate and House of Representatives, and as soon as the chief engineer had completed the preliminaries, he was free to begin the actual excavation work.

Mr. Wallace had planned to have the canal forces fed under contract with J. E. Markell, of Omaha, Nebraska. Markell had made a reputation in the conduct of "eating houses" in the West, and Mr. Wallace felt that he would be able to purvey for the forces on the isthmus better than the commission could. When Chief Engineer Stevens came to look into this matter, he concluded that the canal commission could operate its own eating houses and hotels more cheaply than any contractor could operate them, and the Markell contract was canceled by mutual consent.

One thing in the condition of affairs on the isthmus that was a thorn in the flesh of Chief Engineer Stevens was the eight-hour-day law, which was forced upon him by Congress. Another law which handicapped him in the prosecution of his work was the civil service law, which had been extended to the isthmus, and which had interfered with the plans of Mr. Wallace.

The eight-hour law applied to the common laborer was a hardship on the government, and forced unit costs higher than any one had intended they should go. The civil service law was a handicap in the selection of the force. The application of these two pieces of legislation led him to the conclusion that the best way to build the canal was by contract. In this conclusion he was supported by Chairman Shonts, and President Roosevelt at one time accepted the same view of the matter.

But as Mr. Stevens proceeded further with his work of organization he was finally convinced that the canal should be constructed by the government itself. He found ways to make the civil service law his servant, rather than his master, and the eight-hour day was robbed of some of its disadvantages under the plans he worked out.

Mr. Shonts, however, adhered to the belief that the canal should be built by contract, and urged that view upon the President so strongly that Mr. Roosevelt decided to ask for bids providing for its



The Cristobal commissary neighborhood before and after the sanitary work of 1906-1907.



Eighth and Front Streets in Colon, before and after the Americans cleaned up the city and furnished it with water, sewers and paved streets.

construction under private contract. It was not long before Messrs. Stevens and Shonts were at odds over this and other questions. When President Roosevelt finally decided to support the recommendations of Mr. Stevens, Mr. Shonts concluded that his usefulness in the canal project was at an end, and he resigned. Upon the retirement of Chairman Shonts, President Roosevelt appointed Mr. Stevens to head the commission. About the same time he decided to put army engineers in direct charge of the work, a decision which was most unwelcome to Mr. Stevens.

When Mr. Roosevelt, in February, 1907, designated Major George W. Goethals as chief engineer under the direction of Mr. Stevens, the latter protested for fear that civilian engineers and army engineers could not work together. The upshot of the whole matter was that Mr. Stevens grew impatient with the situation as it then appeared to him, and wrote a letter of protest. He is said to have shown this letter to a friend, who asked Mr. Stevens to withhold it, as it appeared to be equivalent to a resignation. Whether Mr. Stevens really intended to resign or not, President Roosevelt construed the letter as a tender of resignation, and he cabled his acceptance.

In justice to Mr. Stevens it must be said that he never issued any statement indicating his reasons for resigning, and that after he did resign he was always loyal to his successor, and heartily aided the efforts he put forth in the building of the canal.

The proposition of building the canal by contract went as far as the consideration of bids by the Secretary of War. These bids were opened in January, 1907. It was stated that none of them met the terms imposed, and they were all rejected. As a matter of fact, owing to the progress that Mr. Stevens had made in the recruiting of a canal-digging army, the administration had undergone a change of heart, and had decided that the canal should not be built by contract. The terms under which it had been proposed to build the waterway by contract were such that the contractors would have been little more than superintendents of construction, receiving a definite percentage of the total cost of the work.

The decision of Mr. Stevens to leave the government service was due in part to the inherent weakness of the plan of organization. It was this that led President Roosevelt to decide that the next commission should be made up mainly of army men.

The retirement of Mr. Stevens threw the canal army into some confusion, but he had builded so well that it could withstand even the shaking up following a change of administration and a change of leadership without any serious interruption of the work. When Colonel Goethals reached the isthmus he soon indicated that he intended to proceed along the lines that had been laid out by Mr. Stevens. He went there determined to accept everything that was good as a heritage from the Stevens administration, and he found so much that was good that all the changes made thereafter were by evolution, rather than by revolution.

There can be no question that Mr. Stevens proved himself a competent official while on the isthmus, and the evidences of this are to be found in the fact that many of the elements of the organization under which the canal work was carried to a successful conclusion were effected by Mr. Stevens. His own story of his régime at Panama is presented in this volume.

CHAPTER XXIII

THE COMING OF GOETHALS

Secretary Taft Visits the Isthmus with Major Goethals—Goethals Recommended to the President—Wanted Col. Harry F. Hodges to Assist Him—The Commission as Created—No Military Régime for Goethals—"Simply Do Your Duty"—Goethals' Willingness to Give Due Credit to Others—Ready to Assume Responsibility—Investigating from Bed Rock Up—Making the Dirt Fly—Raising the Limit—Reducing Unit-Costs—Cautious in Prediction—A Benevolent Despotism—Going Over the Works—Checking up at Miraflores—A Daniel Come to Judgment—Decisions Cheerfully Acquiesced in—Willing to Forego His Sunday Morning Rest—A Man Who Knows Nothing of the Subtle Arts of Politics.

AFTER two engineers from civil life had demonstrated that the system of canal organization was a failure, President Roosevelt decided that the only way to carry forward the great project was to put at the head of the organization a man who would be compelled, under the rigor of military law, to remain at his post of duty. The army officer selected for this task was George Washington Goethals, then a major in the Engineer Corps.

In 1905, Major Goethals had gone to the isthmus with Mr. Taft, as a member of the general staff, to consider the question of the fortification of the canal. Later when the board of consulting engineers made its report upon the type of canal, Secretary Taft asked the aid of Major Goethals in drafting the report to the President recommending a lock canal. In this way he was brought under the favorable notice of Mr. Taft. Later, General Alexander Mackenzie, then chief of engineers of the United States Army, was called to the White House by the President, where they held a conference concerning the selection of a successor to Mr. Stevens. After this conference, in which Secretary Taft also took part, Major Goethals was called to the White House and told that the army would build the canal, and that he had been selected as the man to direct its operations. President Roosevelt requested him to keep his appointment secret, and to prepare to take the first ship for the isthmus, which sailed three days thereafter. But Mr. Roosevelt could not keep the secret, and the next day the world knew that Major George W. Goethals had been selected for this post.

Major Goethals was asked by the President to suggest the names of his chief assistants. His first request was that Lieutenant Colonel Harry F. Hodges be made one of his associates. He stated that Colonel Hodges' record as the designer of the Soo Locks preëminently fitted him for this position. When President Roosevelt discussed the appointment of Colonel Hodges with General Mackenzie, that officer opposed the suggestion, saying that Hodges was his chief assistant in the river and harbor improvement work of the country and that he could not afford to lose him at that juncture. So the appointment was not made.

On the third Isthmian Canal Commission were Major D. D. Gaillard and Major William L. Sibert of the United States Engineer Corps, both of whom had been engaged for years in river and harbor improvement work; Civil Engineer H. H. Rousseau, who had entered the navy through the civil service and had proved himself to be the ablest civil engineer in the naval establishment; Colonel Wm.

C. Gorgas, who had been the chief sanitary officer under the preceding two commissions; former Senator J. C. S. Blackburn of Kentucky, who was to be the head of the department of civil administration; and Jackson H. Smith, who had proved his ability in the recruiting of the labor forces on the Isthmus.

When Colonel Goethals arrived at Colon there was a feeling in many quarters that his appointment would mark the rise of a strictly military régime. He soon disabused the minds of the canal army on the subject, declaring in a speech that he proposed to be the commander of the army, while the heads of the various departments would be the colonels, the foremen the captains, and the laborers the privates. He added that the organization would be no more military than in the past, except in the precision of its work, and that no man who did his duty, whatever his rank or his station, need have any fear of the incoming administration. "I am no longer a commander in the United States Army," said he. "I am commanding the Army of Panama; the enemy is Culebra Cut and the locks and the dams."

In discussing on one occasion the need of a continuous policy for the permanent organization on the isthmus, Colonel Goethals remarked that there always was a disposition upon the part of a new administration to undo what had been done by previous administrations, if for no other reason than a desire to make a showing. He believed that there ought to be a continuous policy, which would be made possible by the appointment of a vice governor who would be the chief assistant of the governor, and who would become governor in turn. In that way he believed abrupt changes of policy, usually harmful, could be averted. When we survey his administration at Panama we find that he put into effect the ideas he has since advocated in connection with the permanent organization of the canal. While some men have professed to see in him a tendency to take unto himself all credit for the success of the work at Panama, we may read in his very first report his readiness to commend whatever was good that had been done by those who preceded him, and to make the most out of the things which had been done by them. In that report he quotes from the previous administration on the isthmus as follows: "During the year the first stage of canal work, that of preparation, has virtually been passed and the commission finds itself in position to enter upon the second stage, that of the actual construction of a lock canal." Commenting upon this statement Col. Goethals says: "This statement is peculiarly applicable to the Culebra division, on which work had been concentrated, for, irrespective of the type of canal to be constructed, the excavation in this section of the territory had to be done. Moreover, for the time being it was the most important part of the work." That the preparation was efficiently made, and the organization effective, is best attested by the results accomplished and the relatively small decrease of the output during the wet months.

Although Colonel Goethals thus early in his career was ready to praise the effective work of his predecessors, at the same time he was not afraid to make such changes as good business judgment dictated. He found, for instance, that general supervision of the entire ten miles of Culebra Cut by one man was not productive of the best results in fixing responsibility for possible delay. He therefore subdivided the cut into five construction districts, each under the charge of a superintendent of construction, who was held responsible for the work in his district. Better results and less friction promptly followed.

One of the first things to which Colonel Goethals committed himself after arriving on the isthmus was that of checking up every bit of available data gathered for the determination of the type of canal. There had been assertions that the foundations on which the locks were to rest were not solid enough. In order to determine

this question beyond the peradventure of a doubt he had five test pits sunk to solid rock in which he could study the actual conditions that would be encountered. If there ever was a project investigated from bed rock up, the project of building a lock canal at Panama was investigated by Colonel Goethals; and no engineer who visited the canal during his administration failed to come away with a tribute upon his tongue for the scrupulous attention to detail that had characterized the investigations of Colonel Goethals.

When the new chief engineer began to get his bearings after arriving on the isthmus, he promptly decided that his first great duty was to "make the dirt fly." The people at home had grown weary of the era of preparation—they could not understand how necessary to the success of the work these days of preparation were. Their incessant demand now was that the canal army make the dirt fly. Colonel Goethals was alive to the importance of meeting that demand, for he realized that after all public sentiment was the force behind the canal. Every colonel, every captain, and every private in the canal army was asked to get down to work and make the showing which the people of the United States demanded. The result of this call to the shovels was most gratifying. By August of 1907 a rainy season record of 1,000,000 cubic yards a month was established, and President Roosevelt sent to Colonel Goethals and his army a resounding cablegram congratulating them in behalf of the American people for their notable performance. Thus inspired they redoubled their efforts, and in a little while they were removing 2,000,000 cubic yards a month. Still further up the heights of achievement the valiant leader guided his men, and soon 3,000,000 cubic yards a month was the record. Colonel Goethals then determined that this record should be maintained. The army was equal to the demands made upon it, removing 73,000,000 cubic yards of material in two years. Never in the history of engineering had such a high state of efficiency been reached, and never in the history of construction work had half as much material been removed in that length of time.

The demand of the people that the dirt be made to fly had now been met, and Colonel Goethals was ready to turn to the problem of reducing the cost of making it fly. His resolute purpose to do the work as cheaply as conditions would permit resulted in the hammering down of unit costs in a way that is well worthy of being told in a separate chapter.

Colonel Goethals was always cautious in prediction and generous in fulfillment. In 1908 he stated that the high-water mark in the excavation of Culebra Cut probably had been reached. "You see," said he, "as we go down deeper the ditch becomes narrower and there is less elbow room for our steam shovels and our dirt trains. There will be a gradual slow-down, and thus the latter half of the work will move forward much more slowly than the first half." In 1908, Colonel Goethals said that he was afraid that he would not be able to finish the canal in five years from that date. But for the slides which could not have been foreseen, he would have been able to present to the United States a completed Culebra Cut in four years, or even less.

From the beginning of the work under his direction Colonel Goethals was omnipresent on the isthmus. Every morning he spent going over the work in the field and every afternoon he was in his office engaged in administrative duties. No superintendent knew the details of his own end of the work better than the chief engineer knew the details of every phase of the undertaking. He once stated that any one who looked for things to criticise doubtless would find them. "But when you find them, come to me," he added, "and you will not have opportunity to criticise my desire to remove every just cause for criticism." That was the spirit of the man from first to last. Everything was open to inspection—he delighted in

having everything inspected by those who came unheralded and with a desire to learn the truth. Such investigators were given letters directing all concerned to place at their disposal every facility for seeing the work and to give all information the investigator might desire. To Colonel Goethals the unheralded investigator was a means of transmitting a fair statement of conditions to the people back home, who, according to his view, had a right to know.

In the work of maintaining a satisfactory force Colonel Goethals ruled with that firm hand that makes for discipline, with that spirit of justice that makes for contentment, and with that fatherly counsel that makes for peace. When he issued an order he expected it to be obeyed, and it was. He was careful at all times never to ask the impossible. As he went up and down the isthmian highway, sometimes in a motor car, more often in a day coach on a regular train, but most frequently afoot, he talked with everybody he met. Now he discussed the whole sweep of the undertaking with the head of a department; now he made inquiries about the work under the immediate charge of a resident engineer; now it was a steam shovel man; now a dirt train conductor; now a Jamaica negro switch boy. Always he was making mental notes of the answers to his simple questions, and thus keeping in direct touch with every phase of the work.

The following details of a trip through the Miraflores Locks and the dikes below give a characteristic outline of the forenoon inspections by Colonel Goethals. He was at Miraflores by seven o'clock in the morning. Walking through the tunnel at that place he boarded his motor car, and was whisked away to the concrete spillway dam at Miraflores. After ordering his chauffeur to pick him up on the other side of the canal he started over the work. First he was met by Resident Engineer Cole. Climbing up the steep embankment, Colonel Goethals immediately plunged into a dozen details of the work on the spillway dam. "How soon do you think you can make this a finished piece of work? Couldn't you handle another mixer over there to advantage if we can find an idle one? Is there anything else you need to keep things moving along?" These were only a few of his questions. Leaving the spillway, he climbed among concrete mixers and structural steel until he came to some finishing-up work on the upper locks at Miraflores. "Who is doing that work?" he queried. When told that one part of it was being done by the fifth division and another part by the second division, he wanted to know whether in the interest of economy and time it would not be best to have it all done by the one division. As he clambered down the side lock walls he saw the preparations for placing the lamp posts to be used in lighting the locks. He suggested that they could be made less subject to settling if pieces of railroad iron were set into the walls under the lamp post foundations. A little further on he encountered the superintendent of the McClintic-Marshall Company, who had oversight of the work of erecting the lock gates. "When are you going to give us those west chamber gates?" queried Colonel Goethals. "If we have good luck we can let you have them by the first of September, but at any hazard we will be able to give them to you by the first of October," answered Mr. Wright. "This estimate gives due consideration to all delays from rain that you are likely to encounter?" pressed the chief engineer. "Yes, we have taken that into the reckoning," replied the gate builder. "Very well then," said Colonel Goethals, "we shall count on your being ready for us by the first of October."

A moment later, while crossing a temporary bridge across the lofty locks, Colonel Goethals chanced to spy a little railroad track on the bottom of the lock. "I thought all these tracks were to be taken out of the locks," said he to Resident Engineer Cole. "They were," replied Mr. Cole, "but Mr. Wright said we could use this one to bring some of our material

through the locks, as it would not interfere with the gate work at all." "You are sure that it will not afford an excuse for further delay on the lock gates?" "We had a perfect understanding as to that, sir," replied Mr. Cole. "All right, then, go ahead," replied the chief engineer. From this point he went down to the dike which had been thrown across the channel to keep the waters of the Pacific Ocean out of the unfinished ditch extending to the locks. Between this dike and another one like it, which was then holding back the waters of the Pacific, there was a stretch of the sea level channel which was being filled with water from the Rio Grande River. Colonel Goethals wanted to know how much water was going into the channel, how much would be required to fill it, what precautions had been taken to make the dike impervious, how many holes had been bored in the old dike, how much dynamite would be used in blowing it out, and a dozen other things that gave him assurance that the work was going forward properly.

Thence he went over the dam that links the locks to the hills west of the canal, inspected it carefully, and ascertained from the man in charge just when they could promise its completion; now he was talking to a brawny old Irishman who had worked his way up from the bottom and had charge of dumping the trains which were bringing in the spoil for surfacing the dam. It did not matter that this Irishman was old and weather-beaten and grimy—he knew how to dump material and where to put it.

When eleven o'clock had come the whole field had been surveyed by Colonel Goethals's watchful eye. A hundred bits of information had been gathered, and a hundred helpful suggestions had been made. Then the railway motor car turned its cowcatcher toward Culebra, and the presiding genius of America's great waterway was speeding back to an early lunch and an afternoon in his office.

One feature which had much to do with the success of Colonel Goethals at Panama was his manner of hearing and adjusting grievances. Every Sunday morning he was down at his office bright and early, and every person with a grievance was invited to visit him and tell him his troubles. There was no rank or order of precedence in this unique little court of justice. It was a case of the first come, first heard, the only condition being that each man should state his grievance quickly, bearing in mind that there were many following him who had as much right to be heard as he himself possessed. Now it was a negro laborer who complained that he had not received a fair accounting on his time; now it was a railroad engineer who felt that some other engineer had been promoted out of turn; now came a delegation who wanted the coöperation of Colonel Goethals in holding an athletic meet. Here was a group of men who found that a good steam shovel man had been laid off in order to put another on the job because he was a first-class ball pitcher. The next in line was a woman who felt that she had been discriminated against by the district quartermaster in the number of electric lights allowed in her house. Here was a woman whose husband was figuring in one of those eternal triangles that are to be found in every clime.

Each one was heard patiently. The negro laborer who complained regarding his pay check was assured that the matter would be looked into; the railroad engineer who felt that he was cheated out of his promotion was shown his efficiency record and that of the man who was promoted. The delegation preparing for the athletic meet were told that every facility consistent with the service would be provided. The steam shovel man who had seen his place taken by a man who could add strength to the Culebra ball team was told to go to another division where he would be put to work, and was asked to remember that good ball teams added to the contentment of the people on the Canal Zone. He was

assured that he would in no wise suffer by the exchange. The woman with the electric light grievance was hardest to satisfy, but she departed believing that the chief engineer would do his best to adjust matters fairly. The woman who was the victim of the eternal triangle was assured that her husband would mend his ways or be invited to leave the isthmus.

And so justice was meted out. At one time there was a waiters' strike at the Tivoli Hotel. Colonel Goethals promptly issued an order publishing the names of the strikers and forbidding their employment in any capacity at any future time by the canal commission. Again, the engineers threatened to stop every train on the isthmus if one of their number, who had run over a negro laborer, was not released from custody at once. They set a time limit. Colonel Goethals replied that they would receive his answer at the penitentiary, and that any man who stopped his engine because of that answer would be deported to the United States by the first boat leaving the isthmus. His answer was against them, but not an engine failed to move at the appointed time.

Congress gave to Colonel Goethals the power of deportation without appeal, and while it was a power he never abused and seldom used, it made for peace and contentment. No man was more anxious to promote every reasonable aspiration of organized labor and of the individual employee than Colonel Goethals. He could easily have left the hearing of grievances to others. Some of the wiseacres who visited the isthmus proposed that there should be a labor commission to attend to these matters. Colonel Goethals replied that he wanted to keep in the closest touch with every condition on the isthmus, and that his Sunday grievance court afforded the best agency of doing so. Ambassador Jusserand of France, who attended one of these sessions, remarked that it reminded him of the court of justice held by Saint Louis beneath the majestic oak at Vincennes.

Colonel Goethals had a very fixed idea as to the usefulness of this plan. He said on one occasion that only in a very small percentage of the cases could he grant the requests of complainants, but that his readiness to devote Sunday mornings to hearing them was taken as proof of his earnest desire to "see that every one got a square deal," and thus allayed discontent. "If you think that the time has come when the machinery of the canal army moves without friction and without jar," said he, "you will have your mind disabused if you will come up to my 'at home' next Sunday."

Colonel Goethals cherished no false notions about his position. He said that he realized full well that a single false step on his part might bring down upon his head the criticism of the people of the United States. But he did not employ modern methods to exploit his personality. He seemed to rely upon the character of his work. He knew nothing of the subtle arts of politics. There were a thousand men under him who had better sources of confidential information from the National Capital than he possessed. In his dealings with Congress he was always the soul of frankness; he never asked of that body anything that was not needed, and his greatest effort on the isthmus was to make every dollar go as far as it could.

Colonel Goethals was always ready to accord to every man the credit that was his due in the work at Panama. He said frequently that if either Wallace or Shonts had been permitted to operate on the lines pursued by corporations in great undertakings, either could have completed the canal without question. He also stated that too much credit could not be given to Stevens for the work of providing the facilities for digging the canal, and that without this work the army itself might have failed.

CHAPTER XXIV

CULEBRA CUT

DIVORCING MOUNTAINS AND WEDDING OCEANS—FORTUNATE THAT CONGRESS DID NOT FORESEE DIFFICULTIES ENCOUNTERED—THE WORLD'S ONLY ARTIFICIAL CAÑON—BATTLING WITH THE SLIDES—A WONDERFUL SCENE—PRESSING FORWARD AT TOP SPEED—THE USE OF DYNAMITE—SHOVELING UP THE SPOIL—HAULING IT TO THE DUMPS—THE LIDGERWOOD EQUIPMENT—A HUNDRED AND ONE INVENTIONS—THE NAOS ISLAND BREAKWATER—TROUBLES IN THE RAINY SEASON—TWO FARMS GOING INTO THE CANAL—UNCANNY TRICKS BY SLIDES—A MISTAKEN BOARD OF CONSULTING ENGINEERS.

THE engineers at Panama have been able figuratively to wed the oceans only by literally divorcing the mountains. From the Arctic to the Antarctic there stretches a vast and lofty mountain chain, dividing the East from the West on two continents. The task that confronted the American engineers was that of cutting through the weakest of the links of this chain of mountains. When it was proposed to build the Panama Canal there were those who believed it possible to cut down the backbone of the Cordilleras until the waters of the oceans could sweep through unhindered to a depth which even at low tide would carry the largest steamship afloat. There were others who held that a more feasible plan would be to lift up the waters, so that they could meet and mingle, not above the mountain tops, but at least a part of the way above the sea. The latter idea prevailed, and to the fact that it did prevail the American people owe their triumph at Panama.

In all the world of work there is perhaps no better example of the wisdom of the Infinite in withholding from man a knowledge of the future; for if the American people had known of the tremendous difficulties that lay before them in their work of severing the link that united two continental mountain systems into one chain, it is doubtful if that work would ever have been undertaken. If some prophet, speaking with foreknowledge, and not without honor in his own country, had come to the Congress of the United States in 1902, stating to that body that it would cost $10,000,000 a mile to dig Culebra Cut at its present level, and that it would require the excavation of over 100,000,000 cubic yards of material, there would have been no Culebra Cut and no Panama Canal to-day.

There now stretches through the backbone of the intercontinental divide a cañon cut by human beings, the only one on the earth. Nine miles long, with an average depth of 120 feet, with a bottom width of 300 feet, and with a top width which reaches at places to a third of a mile, this marvelous cañon presents at once an inspiring and awesome aspect, revealing both man's audacity and nature's grim resistance to his efforts. On either side of the gorge rises a majestic peak, standing as sentinels guarding the passage from the Atlantic to the Pacific. But now, where once they were bound together with chains of primeval rock, they are separated by the arm of a lake, the largest yet created by human cunning. Where once the Chagres river encountered immense barriers which turned it about and forced it to flow into the Atlantic, now it comes down into that wide lake, whose waters may be made to flow either into the Atlantic or the Pacific, at the touch of a button.

To accomplish this wonderful work, the American canal army was called upon to



1. The late Col. D. D. Gaillard, the genius of Culebra Cut.
2. View from Cucaracha slide looking toward Pedro Miguel, whose locks appear in the background.
3. View from Contractor's Hill, looking past Cucaracha slide.





1. Upheaval in the bottom of Culebra Cut.
2. View of the basalt formations at Gold Hill, in Culebra Cut.

go to lengths unprecedented in the history of engineering. A thousand and one unforeseen difficulties arose. Nature interposed her powerful self between the canal engineer and his purpose, and seemed to take almost fiendish delight in a defensive warfare against his labors. She manœuvered her forces with consummate cunning, in a way best designed to strike terror to the hearts of those against whom she was defending that mountain pass. Now she sent down slides which threatened to disrupt the whole system of excavation in the cut; now these slides became quiescent, as if to lull the engineer into a false security; now they made a feint, threatening dire results, but stopping short of actual conflict; now they came in the dead of night, spreading chaos in every direction; now they seemed to raise the white flag of surrender, allowing the dikes of basalt to peep out as a message to the engineers that the slides could move no further because they were tied by these dikes to the very core of the earth; and then they would destroy the hopes which these dikes aroused by shearing them off as if they were but pipe stems, and flowing, unrestrained, into the cut.

But through all their trials and tribulations, through all their delays and repulses, the canal engineers led their forces onward, checking the slides and retrieving every inch of lost ground, until Nature herself lay exhausted at their feet and accorded them the triumph for which they had struggled so long and so persistently.

As we look back over the story of Culebra Cut we are struck by the constantly rising limit of the amount of material to be excavated. A few months before Colonel Goethals took charge at Panama, the amount of material which it was thought would have to be removed was less than 54,000,000 cubic yards. As we survey the completed project we find that there has been removed more than 100,000,000 cubic yards; that the cut has been dug at an outlay of nearly $10,000,000 a mile, and that the heaviest miles have cost as much as $15,000,000; that the slides added some 30,000,000 cubic yards of material, to say nothing of the unforeseen difficulties which they brought into the cut with them. We find that there has been taken out almost as much material to make a lock level cut as was estimated for the sea-level cut. We find that there was taken out of Culebra Cut to bring it to the stage of completion as much material as it was estimated would have to be removed to complete the canal from the Atlantic to the Pacific.

Whether the cut was viewed from the hills above, or from the bottom of the ditch below, it presented, during the construction period, a strange admixture of awesome proportions and apparently chaotic conditions; but what seemed to be chaos and confusion was in fact order and system. Hundreds of well drills, tripod drills, and hand drills ate their way down through the rock, preparing the holes in which were to be planted the tons of dynamite used to provide the daily spoil for the forty-odd steam shovels that consumed the vitals of the cut. Dozens of dirt trains moved to and fro, as they took the spoil from the shovels and carried it to the dumps, which were an average of some twelve miles distant. Necessarily there was order and system when the daily stint was that of loading and hauling away 160 trainloads of material from a cut nine miles long.

The work moved forward at a pace unprecedented in the annals of engineering. In the nine-mile section in a single twelvemonth there was removed a total of 16,586,000 cubic yards of material. Six thousand men labored within this short stretch, preparing for the blasts, handling shovels and the dirt trains, and shifting the tracks as the work moved forward. At eleven o'clock in the forenoon and at five in the afternoon the cut was temporarily deserted; and then there came the thunderous blasts that tore loose the rock and provided the next four hours' supply of food for the steam shovels.

Dynamite was used in enormous quantities. No mind can conceive of the tremendous force of 60,000,000 pounds of high powdered dynamite, the amount used by the engineers in tearing asunder Gold Hill from Contractor's Hill. Were the holes that were drilled in preparing for the work of the dynamite put end to end, they would more than reach through the earth itself, at the equator. Great batteries of the largest well drills, lined up in rows, drove down through the solid rock, to an average of twenty-four feet in depth; a whole company of tripod drills hammered their noisy way down into the adamant; while here and there gangs of negroes, swinging heavy sledges to the rhythm of some folk lore song, drove the steel hand drills inch by inch into the rock. In the case of the wells a small amount of dynamite was sent to the bottom and exploded in order to "spring" the hole. Then hundreds of pounds of explosives were put down into these wells, tamped home, and connected with wires bearing high-power current from the electric light plants. The turning of a switch made the earth shake and shattered the embedded rock. More than 600 holes were fired daily. In addition to these there were small "toe" blasts and many "doby" blasts. The handling of dynamite is never free from dangers, but the Culebra Cut work was so well ordered under the rules formulated by the chief engineer, that only eight men were killed in the handling of 19,000,000 pounds of explosives. In the early years of the work blasts were set off by simple dry batteries, but it was found that this frequently resulted in a failure to explode the charge, with constant danger of premature or unexpected explosions. The substitution of the other method insured the explosion of every charge. The largest single blasts at Panama were set off in a series of holes containing 52,000 pounds of dynamite. The most serious accident that ever occurred was at Bas Obispo, December 12, 1908, when 44,000 pounds of dynamite exploded prematurely, at the moment when the last load was being tamped home. Great care had to be exercised in preventing premature explosions. The action of warm moist air on the iron pyrites sometimes heated the material, causing a blast to go off while being tamped home. To overcome this, a stream of water was played into the hole before the dynamite was put down.

After the blasts had been fired, the steam shovels appeared. Some of them could pick up eight tons of material at a mouthful and take a new mouthful every three minutes. One ninety-five-ton Bucyrus shovel handled 543,000 cubic yards of material in one year. The record for a month was 86,844 cubic yards. The average output per shovel ran up from 500 yards a day in 1905 to more than double that amount in 1912. There were forty-three shovels at work at the height of activities in Culebra Cut. To handle the spoil that could be loaded upon the trains required the services of 140 locomotives and 3,700 cars. In a single year the shovels loaded 1,119,000 carloads of material, and 75 trains were constantly going in and out of the big ditch. When the work reached the climax there was a train in or out nearly every minute of the working day.

The bulk of the spoil was hauled away on Lidgerwood flat cars. Each car held about nineteen cubic yards of spoil, and they were run in twenty-one-car trains. The cars were boarded upon one side only, and steel sheets were hinged from the floor of one car to the floor of the one ahead, so as to give, to all intents and purposes, a solid car floor for the entire length of the train. When a train was loaded, it was pulled out of the cut and hauled to the dumps. Here a huge plow, reposing on a car that had been unloaded previously, was attached to the train at one end, while a car carrying a large steam windlass was attached to the other end. A cable the size of a man's wrist was stretched from the windlass to the plow. When the train was in position for

unloading, the windlass began to turn, pulling the plow along on the floor of the cars until they were unloaded. Then the car on which the plow finally rested and the one on which the windlass rested were cut out of the train, and it was hauled back empty.

The heavy cable that pulled the plow over the floor of the train was stretched in an ingenious way. There was a frame built across the track like those which support the warning ropes at overhead bridges and tunnels. The train to be unloaded ran through this frame, switched in the car containing the windlass, and attached the end of the cable to the frame. As the train moved back, the cable was stretched along the length of the train, and was ready to be attached to the plow as soon as the car carrying it was attached to the train. All this indicates that there was considerable switching in placing the cars containing the windlass and the plow into the train and cutting them out again. There was; but the men who did it became so adept that there was comparatively little delay.

After the plow had removed the dirt from the cars and the empty train had started back for another load, another engine came along with another sort of plow. This plow ran along the track and pushed the dirt down the bank. It was followed, in turn, by a track shifter, which lifted the track over bodily to the new position that the widened bank made possible. And thus the work went forward. Every operation that could be performed by machinery was taken out of the hands of the laborers. Each of these inventions made it possible for one man to do the work of dozens. Each car gave up its load in a half minute; the spreader forced a trainload of rock and earth down the bank in ten minutes; and the track shifters always had the track moved over by the time the next train was ready to discharge its burden.

From time to time many improvements were made in these different devices. As originally constructed the floors of the Lidgerwood cars extended the same distance over the wheels on both sides. This did not permit a proper centering of the load, necessitating its being placed too much on the boarded side, which resulted in an excessive wear and tear on the wheels of one side of the car. An apron was therefore built on the other side of the car, which extended the floor a foot or more over the wheels. This permitted the load to be centered, and at the same time permitted the plow to throw the material further away from the track. It also gave the car a nineteen-yard capacity where it formerly had a sixteen-yard capacity.

The cables at first were likely to break when the plow struck an obstruction, such as a large stone or a broken car-floor; a weak link, with a breaking-point just a little weaker than that of the cable, overcome the difficulty. Couplers sometimes became worn or broken under hard usage, causing the parting of a train at times when it was desirable that such things should not happen; a master mechanic invented a kind of "bridle" that saved the day here. The plows sometimes caught the edge of the side board at the end of a car; a bullnose piece of iron was devised, which steered the plow away from the side boards. Some fifty-odd improvements were made on the spreaders alone.

In addition to the Lidgerwood equipment for hauling away the spoil, a large number of Western Dump Cars, dumped by compressed air, and a number of ordinary cars, dumped by hand, were used. At the height of the work 333 trainloads of material were handled by the Central Division in a single day, the bulk of them coming from Culebra Cut.

The disposal of the spoil was a serious problem. Over a hundred million cubic yards of material had to be hauled away and dumped. With a part of it the engineers converted an island into a peninsula, three and a quarter miles out in the Pacific Ocean. This peninsula is the Naos Island

Breakwater, which serves the double purpose of providing communication between the mainland and the Pacific fortifications, and preventing the cross currents of Panama Bay from filling up the end of the canal with silt. With another part of the spoil they converted nearly 500 acres of the Pacific Ocean into a town site and a military reservation. With still another part of it they made a parade ground. But still scores of millions of cubic yards of this débris had to be hauled out and dumped in the jungle. In one of these big waste dumps 17,000,000 cubic yards of material were disposed of.

The Naos Island Breakwater was the most troublesome work on the isthmus. At one spot it settled 125 feet. In not a single foot of its more than three miles of length is the original trestle to be found under the tracks it was meant to support. It sank down and shifted to the side, at some places as much as 300 feet from the spot where it was put down.

Disposition of the spoil in the wet season was difficult. Imagine a dump covering perhaps 1,000 acres, and with tracks over its several terraces. Then picture a rainfall twice as heavy as that which occurs in the United States, dashing down and converting this great dump of freshly excavated material into a sea of mud. Then fancy the dirt trains running through that sea of mud, with the track sinking three or four feet, and shifting to one side or the other. Then watch the trainmen working and toiling to extricate their trains. That is what might have been seen hundreds, if not thousands, of times at Panama. But through it all, and in spite of it all, the trains kept running and disposing of the spoil, for when the trains stopped, all other work ceased.

We now come to the slides; and no man who ever saw them working their way into Culebra Cut can fail to see in them the handwriting on the wall—the handwriting that says that no sea-level canal shall ever be built at Panama. Bringing into Culebra Cut more than 250 acres of land, buildings, and all; driving downward 30,000,000 cubic yards of material which ought never to have come into the cut; imposing upon the canal engineers not only the task of removing all this extra material, but multiplying the difficulties under which the material which belonged in the cut was removed,—the slides were Nature's heavy artillery, indeed, in repelling the invasion of man.

They were absolutely unforeseen. No one dreamed that material would move into Culebra Cut in quantities vast enough to load a train of cars reaching half way round the earth, and requiring the equivalent of a string of locomotives 700 miles long to haul it away. Nor did any one foresee that the cut would be choked up repeatedly, now disrupting one-half of the entire transportation system, now disrupting the other half. A total of 200 miles of railroad track was covered up, destroyed, or dislocated in a single year by these slides. The very bottom of the cut itself was upraised sometimes as much as 18 feet, as if to recover the ground lost by the operation of the steam shovels and the dirt trains.

It was more than the mere digging of a ditch that Colonel Goethals had to encounter when seventy-five acres of the town of Culebra broke away and moved foot by foot into the canal; carrying hotels and club houses with them until these buildings were removed. Cucaracha slide carried into the cut many millions of cubic yards of material, bottling up the channel, and sending its "toe" sixty-odd feet up the other side. It was fight, fight, fight, now with dynamite, now with steam shovels, now with hydraulic excavators, and now with dredges. The campaign finally resolved itself into one of inviting the slides to do their worst, and then meeting them as they came. Some of them, like Cucaracha, were mere masses of material slipping by force of gravity into the channel; others, like the West Culebra slide, were breaks. If a cut is dug deep enough, even side walls of granite





1. Slides which carried 230 acres of earth into the canal.
2. Steam shovel caught in a slide.

finally will break at the bottom, causing the material above to press down and into the cut. This is what happened at West Culebra. The material at the bottom broke, and the material above forced its way down, and like water poured into a U tube, rose up on the other side—the other side in this case being the bottom of the canal.

Sometimes these breaks played uncanny tricks. At one place a steam shovel, track and all, was picked up and carried half way across Culebra Cut, where it was left unharmed. At another place, where three tracks were close together, the one nearest the bank sank down several feet, and the one farthest from the bank rose up correspondingly, while the middle one was not disturbed. One slide kept a gradual motion, moving down just as fast as the steam shovel worked, so that the shovel was able to make 103 trips across the "toe" of the slide without shifting its track an inch.

Cucaracha, with its fifty acres or more of sliding material, was first in the field, having paid the French a visit that drove them from that part of the Culebra Cut. Again in 1905 it came down, and once more in 1907. Intermittently it has been in motion ever since. At one time it broke so far back that the rear part sloped away from the canal. Then a hydraulic jet, with a nozzle pressure of eighty pounds to the inch, was turned on the materials that drained away from the cut, and they were sluiced back into another valley.

The actual delay in the completion of Culebra Cut because of the slides cannot be ascertained accurately. If the slides had not involved any other difficulty than that of removing them the delay would have been twenty-two months. But when we reckon all the hindrances to the other work, it is probable that the total delay involved is not less than two and a half years. In other words, but for the slides, Colonel Goethals and his lieutenants would have completed Culebra Cut by the first of January, 1912; they would have removed the 70,000,000 cubic yards of material, other than the slides, in five years, although the board of consulting engineers said it would require eight years to remove 54,000,000 cubic yards; and they would have removed the larger amount with forty steam shovels, although the board of consulting engineers estimated that it would require 100 steam shovels to remove the smaller amount.

The board of consulting engineers, in fact, went astray in dealing with Culebra Cut. Serious results would have followed the adoption of their recommendations. They reported that a sea-level Culebra Cut would require the excavation of only 110,000,000 cubic yards of material; it has taken almost that much work to build the lock-level cut. It would probably require the removal of another 100,000,000 cubic yards to bring the present cut down to sea level.

Those engineers in the majority report ridiculed the idea of encountering any serious difficulties in Culebra Cut; they said its banks would stand up with an average slope of three feet rise on two feet back; yet at some places there is only one foot rise to ten feet back. They said a hundred shovels could be operated in Culebra Cut; the highest number operated was forty-three. They said handling the slides was only a question of drainage; and yet the worst ones occurred in the dry season.

The American people probably owe it to Mr. Roosevelt that their enterprise at Panama did not fail as ingloriously as the French project. If he had not possessed the moral courage to change his own mind, and to come out against such a powerful majority as that on his board of consulting engineers, the country would be awaking to the discovery that a sea-level canal is an impossibility—so far as pocketbooks and patience go—instead of putting the finishing touches on the lock canal. Meanwhile there would have been expended some $50,000,000 in digging a sea-level ditch from Gatun to Gamboa; some $8,000,000 on a masonry dam at Gamboa, and as much more on tidal locks at Sosa Hill—only to find that none of these expenditures would have been of value in building a lock canal.

CHAPTER XXV

BUILDING THE DAMS

MAKING A LAKE OUT OF A RIVER—THE CHAGRES VALLEY AS A PLACE FOR A LOCK CANAL—THE DIMENSIONS OF GATUN DAM—HOW THE "TOES" OF THE DAM WERE BUILT—MAKING A CORE OF NATURAL LIQUID CEMENT—THE GATUN SPILLWAY—HOW IT IS OPERATED—THE MOODY CHAGRES—FACILITIES FOR TAKING CARE OF TWO RIVERS LIKE IT—DRIVING A HYDRO-ELECTRIC PLANT—FIRST SUGGESTION OF GATUN AS A DAM SITE—JOHN F. STEVENS FAVORED IT—OBJECTION TO A LOCK CANAL ON ACCOUNT OF GATUN DAM—SEVILLE CONDUCTS THE EXPERIMENTS WHICH DETERMINE THE CHARACTER OF THE STRUCTURE—A DAM THAT BURST WHERE THERE WAS NO DAM—PRESIDENT-ELECT TAFT AND HIS CONSULTING ENGINEERS VISIT GATUN—GATUN DAM A HAPPY SURPRISE—THE DAM AT PEDRO MIGUEL—THE WORKS AT MIRAFLORES—THE ABANDONED SOSA HILL LAKE.

THE construction of the Panama Canal required the construction of three dams, two on the Pacific side and one on the Atlantic side. The dam at Gatun is so huge in its proportions, and was for years the subject of so much controversy, that it eclipses the two dams on the Pacific side. The vastness of its proportions can scarcely be conceived. It is really nothing more or less than a hill thrown across the Chagres valley, so as to impound the waters of the Chagres River, converting them into a lake with an area of 164 square miles, and with a shore line of 1,016 miles. The Chagres River drains a watershed of 1,320 square miles. The average rainfall on this watershed approximates 100 inches annually. It is the mission of the Gatun Dam to impound enough of this water in the lake to carry the commerce of the world across the continental divide, and to provide lockage water for putting the ships through the locks at the two sides of the isthmus. The dam impounds 183,000,000,000 cubic feet of water, or practically as much as the Chagres River brings down in an average year.

The valley of the Chagres was framed by the hand of Nature in such a way as to fit admirably into the plans of the canal engineers for a lock canal across the isthmus, with the Atlantic locks at Gatun. In the upper and middle reaches of the valley, after the river strikes the line of the canal, the hills which border it are far flung. As you approach Gatun, coming down the valley, they swing in toward the canal on both sides, and at that point are only a mile and a half apart. Midway across this valley there was a small hill with a foundation of rock. The problem was simply one of building a dam between the hills at the two sides of the valley, utilizing the small hill in the middle of the valley as a site for the spillway, through which the surplus waters in the lake should be passed over the dam and down into the sea. The dam which was built is a mile and a half long, half a mile wide at the base, 300 feet wide at the water line, and 100 feet wide at its crest. It is 105 feet high, making the crest twenty feet higher than the normal surface of the water in the lake. The dam contains 22,000,000 cubic yards of material. Its total weight approximates 30,000,000 tons. It covers 288 acres of ground, and contains enough earth and rock to build a fence eighteen inches thick and three feet high around the earth at the equator; or a wall around the State of Ohio ten feet high by twelve feet wide.

In the construction of the dam two parallel ridges of stone 1,200 feet apart were

first thrown across the Chagres valley. The height of these ridges ranged from thirty feet on the down-stream side to sixty feet on the up-stream side. Between these ridges, which were technically known as "toes," there was built up a dam of earth. The central portion of this earth-dam is known as the hydraulic core. Huge dredges were put to work breaking loose the soft natural cement of the valley below the dam and pumping it into the great pond maintained on the surface of the dam as it rose upward. The material carried in suspension in the water was allowed to settle, and then the water was drawn off and sent back for another load of liquid silt. In this way there was built across the valley, in the heart of the dam, a wall of natural cement 850 feet wide at the base and as high as the dam itself.

After the dam was built to its desired height, the entire up-stream side was armored with stone. Wherever the wave action is strong, huge boulders weighing many tons are planted on the face of the dam, to break the force of the waters. Although the dam impounds the largest artificial lake in the world, its bulk is so great that sixty-three pounds of material would have to be pushed aside for every pound of pressure that can be brought against the dam.

The spillway by which the surplus waters brought down by the Chagres into Gatun lake are passed to the sea is a most interesting structure. It consists of a large semi-circular masonry dam built on the small hill in the middle of the valley, with the arc jutting up into the lake. On the crest of this dam were set thirteen piers and two abutments, making fourteen openings, each of which is forty-five feet wide and twenty feet high. Huge gates close these openings, moving up and down on roller bearings. They weigh forty-two tons each, and are operated by electricity. The water is permitted to pass through these openings, and the torrents thus created are made to converge at the bottom of the spillway, so that their fury is neutralized as they rush together. In addition to this, there are huge steel-faced baffle piers erected near the bottom of the spillway apron, which further arrest the maddened waters as they make their sixty-foot plunge from the surface of the lake to the surface of the river channel below. The spillway is so constructed that whenever the water flows deeper than six feet it adheres to the apron of the spillway instead of rushing over and making a perpendicular descent.

The Chagres River is one of the moodiest streams in the world. Now it flows along as a peaceful, lazy little tropical river not over two feet deep, moving sleepily on its journey to the sea. A day later it may become a wild, raging torrent, forty feet deep, madly hastening on toward the sea. Once there was nothing to oppose its moods, and it swept out to sea like a tidal wave. But to-day the mouth of the Chagres, properly speaking, is no longer at the Caribbean Sea; it is some thirty miles inland, at Gamboa. What once was the valley of the Chagres between Gamboa and Gatun is now Gatun Lake, and the Chagres flows into it at Gamboa instead of flowing into the Atlantic Ocean at Fort Lorenzo. Now the river may rage, coming down from its upper watershed with as great a flood as it has ever been known to carry, but the lake into which it flows is so extensive that angry torrents of the Chagres are swallowed up and scarcely disturb the placid surface. When the lake reaches eighty-seven feet, the spillway has a capacity of 145,000 cubic feet per second, which is 17,000 cubic feet more than the Chagres has ever carried. In addition to this the big culverts in the locks can dispose of 50,000 cubic feet per second. At ninety-two feet the capacity of the spillway and locks becomes 262,000 cubic feet per second, which would take care of two Chagres rivers instead of one. During the rainy season observers of the Chagres are placed above Gamboa, who telephone the stages of the river to the operators at Gatun. There is no danger that the operators at Gatun will ever be caught

napping for a period of two days while the Chagres is on a rampage, and inasmuch as the capacity of the spillway, even at the normal lake level, is greater than the water-carrying capacity of the Chagres at its flood stage, the Chagres has been robbed of all its terrors. It has been transformed from a menace to the canal into a burden-bearer of commerce. Not only will it bear the burden of maintaining the level of the lake in the thirty-five miles stretch from Gatun to Pedro Miguel, but it will also be called upon to furnish the water which will drive the turbines of the hydro-electric plant at Gatun spillway, where the power for operating the locks, operating the terminal facilities, and lighting the Canal Zone settlements will be generated. Furnishing the water for the middle thirty-seven mile stretch of the canal, for the locks, and for the hydro-electric plant, the Chagres River has been made the major factor of the great trans-isthmian highway. It has become the friend of the lock canal, where it would have been the foe of a sea-level canal.

The first suggestion of Gatun as a proper site for the locks on the Atlantic isthmus was made in 1879 by Godin de Lepinay, who was chief engineer of bridges and roads in France. He tried to induce de Lesseps to give real consideration to engineering figures on his proposition to build a lock-type canal, but de Lesseps dodged the issue. De Lepinay then wrote his own report, setting forth objections to a sea-level canal, and presenting the advantages of a lock canal at Gatun. That report has been proved a very far-seeing one by experience at Panama. The reasoning he employed against a sea-level canal, and that which he urged in favor of a lock canal, is amply vindicated by facts ascertained in the actual construction of the highway. When the Walker Commission took up the matter, they followed de Lesseps's plan for a dam at Bohio. The first chief engineer of the present canal, John F. Wallace, took little interest in investigations at Gatun, because he advocated a sea-level canal. It was the second chief engineer, John F. Stevens, who recommended the site at Gatun, and upon his careful investigations the decision to build the dam and locks there was reached. One of the principal objections urged to a lock canal was that a stable dam could not be built at Gatun. How little this objection was justified is shown by the success that attended the construction of Gatun Dam.

The fight against a lock canal was kept up even after that type had been authorized by Congress, and those who opposed the lock canal centered their attack upon Gatun Dam. They declared that underground rivers flowed beneath the valley of the Chagres, and that there was no hope of building there a dam which would impound the waters of Gatun Lake. Colonel Goethals, as soon as he took charge, determined to ascertain just what the situation was beneath the surface of the valley. He called to his aid Caleb M. Seville, one of the foremost earth-dam experts of the world, who had been in charge of the work on the Wachusetts Dam in Massachusetts. They honeycombed the site of Gatun Dam with borings, and sank test pits here and there, so that they could go down and see with their own eyes the various strata of the proposed foundation of the dam. Never was the site of any structure explored more thoroughly than was the site of Gatun Dam. They found that the alleged rivers beneath the valley of the Chagres had no existence except in the imagination of those who opposed the building of a dam at Gatun. After they had satisfied themselves as to the site, they next took up the work of determining the properties of the materials with which the dam was to be constructed. They modeled experimental dams drawn to scale, and brought varying water pressures against them. They filled huge steel cylinders with the material they proposed to put into the dam, and exerted a water pressure upon it equal to a head of water twice that of Gatun Lake; and



1. Brig. Gen. William L. Sibert, builder of Gatun Dam.
2. Pipe line dredge pumping silt to crest of dam making natural cement core.
3. Lake side of dam, riprapped to prevent destructive wave action.







1. The lake side of Gatun spillway dam.
2. The water after passing over the spillway.
3. Down-stream side of the spillway dam.

the trace of seepage through three feet of this material was nothing but perfectly clear water. It was obvious that if three feet of the material was impervious under such a pressure, there could be no question about the 800 feet of it to be used in the dam.

When the stone in one of the "toes" of the dam sank in 1908, a sensational dispatch was sent to a New Orleans newspaper stating that the dam had given way. This report was spread broadcast, and it so stirred the nation—for the people had not stopped to think that there was as yet no dam at Gatun to give way—that President Roosevelt asked President-elect Taft to go to Panama to investigate the situation. The net result of this investigation was that the engineers who accompanied Mr. Taft—Messrs. F. P. Stearns, Arthur P. Davis, Henry A. Allen, James D. Schuyler, John R. Freeman, and Allen Hazen—decided that the dam was being built with a greater margin of safety than even the utmost precaution required. They reported that the crest of the dam should be cut down thirty feet, and that there was no necessity for driving interlocking sheet piling across the valley as a precaution against imaginary underground rivers.

The completed Gatun Dam has proven a happy surprise. It has shown itself to be water-tight beyond all engineering demands; it has become such a part and parcel of the topography of the Gatun region that it seems to be nothing more than a hill of very gentle slope, thrown by the hand of Nature across the valley at Gatun. Nature has adopted it as a part of her own work, having covered it with a dense cover of jungle growth which relieves it of every indication of artificiality.

At Pedro Miguel the valley to be closed up was half a mile wide. Here a very small dam, thrown from the locks to the hills on the west, acts as a cork for the Gatun Lake bottle, of which Culebra Cut is the neck. At Miraflores there are two small dams. The construction of the west dam is similar to that at Gatun, and runs almost parallel with the locks. This was made necessary in order to control a small river during the period of lock construction at Miraflores. More than a dozen of these small rivers were haltered and led about by the canal diggers during the work of completing the canal. Some of them were forced to change their beds several times before they were finally permitted to resume an age-long repose.

At the outset of the work at Panama it was intended to create a large lake at the Pacific end of the canal, by throwing dams across depressions between Ancon Hill, Sosa Hill, and the hills to the west of the canal. It was found, however, that instead of costing $4,000,000, dams at these points would cost $11,000,000. Furthermore, locks and dams at Sosa Hill would have been exposed to an enemy's fire from Panama Bay, while Miraflores is out of the range of hostile guns. These considerations led to the abandonment of the projected lake, and the digging of a sea-level canal from the Pacific to Miraflores followed.

CHAPTER XXVI

THE STORY OF THE LOCKS

THE FUNCTION OF THE PANAMA LOCKS—THEIR DIMENSIONS—THE WATER CULVERTS—THE LOCK GATES—HOW THE GATE LEAVES ARE MOVED—PRECAUTIONS AGAINST ACCIDENT IN THEIR MOVEMENTS—MAKING THE GATE CONTACT WATERTIGHT—SAFEGUARDING THE OPERATIONS OF THE LOCKS—HUGE FENDER CHAINS—AUTOMATIC PUMPS—TOWING LOCOMOTIVES—EXTRA SAFETY GATES—THE EMERGENCY DAM—ACCIDENT AT THE SOO LOCKS—ELIMINATING THE PERSONAL EQUATION—LITTLE GATES AND BIG GATES—GREAT USE OF CONCRETE—CABLEWAYS AND ELECTRIC RAILROADS—MIXING CONCRETE AND WIGWAGGING IT INTO POSITION—USING CRANES ON THE PACIFIC SIDE.

THE great locks at Panama through which ships are lifted up from the sea to Gatun Lake and back down to the sea again, after a thirty-seven-mile sail through fresh water, constitute a vast and wonderful engineering work. Their total cost approximates $60,000,000. With their approach walls, their aggregate length is nearly two miles. There are three steps on each side of the isthmus by which ships are lifted up 85 feet on the one side and let down 85 feet on the other. Each of these steps has two lock chambers, making parallel shipways through the locks. The side walls vary from 45 to 50 feet wide at the floor of the locks, and at a point 24⅓ feet above the floor they begin to step in 6-foot steps until they are 8 feet wide at the top. The total width of the locks between the two side walls is 280 feet. In the middle of the locks, and running parallel with the side walls, is a center wall, which divides the locks into two chambers. This wall is 60 feet wide all the way up. At a point 42½ feet above the floor of the lock the solid construction ceases, and a U-shaped opening runs the entire length of the wall. This serves to provide three long tunnels, the full length of the center wall, one above the other. The lowest of these tunnels is used for drainage purposes; the middle one is used for the conduits through which the electric cables are run; the upper tunnel is used as a passageway from one piece of operating machinery to another.

Running lengthwise through the side and center walls are three large water tunnels, or culverts, eighteen feet in diameter—large enough to accommodate a modern passenger train. These huge culverts are used to carry the water down from the lake into the several locks. From these tunnels extend a series of cross culverts which pass under the floor of the locks. There are fourteen of these cross culverts in each lock chamber. Seven of them open from the side culvert and seven from the center wall culvert. These cross culverts are large enough for the passage of a two-horse team. Through each one of them there are five openings into the floor of the lock chamber itself, making seventy in all in the bottom of each lock chamber. These holes are so large that a sugar barrel could pass through each one without difficulty. The passage of water through the culverts is controlled by a large number of valves. In the large wall culverts, these valves consist of two huge gates, each 8 by 18 feet, which slide up and down in frames after the manner of a window. Each of these gates weighs ten tons, and must be able to hold in check a head of sixty feet of water. The gates which control the passage of the water from the wall culverts to the cross culverts have ordinary cylindrical valves. They are so

arranged that each one may be opened or closed independently, or they may be opened or closed in series.

The gates which separate the several chambers of a flight of locks are of enormous size, ranging from 47 to 82 feet high, and are 7 feet thick. They are built in two leaves to each gate, each of these leaves being 65 feet wide. The weight of the leaves varies from 390 tons to 730 tons, depending upon the height of the leaf. They are swung to the walls of the lock chamber in such a way that when they are closed they extend across the lock in the shape of a flattened V, with the apex pointing in the direction from which the pressure comes. The lower sill of each gate leaf weighs approximately eighteen tons. The gates are built up of structural steel, and are covered with large riveted steel plates, just as the hull of a ship is covered. Each of these gate leaves is hung on huge pintles anchored to the walls of the lock. The hinges that are hung on them weigh 36,752 pounds each. They were made to stand a strain of 40,000 pounds before stretching, and 70,000 pounds before breaking. Under an actual test it was found that they were able to stand a strain of 3,300,000 pounds before breaking.

The movement of a gate leaf is accomplished through a huge connecting rod, one end of which is attached to the leaf about midway between the wall and the other end of the leaf; the other end is attached to a huge master wheel which lies flat on the top of the lock wall. This master wheel weighs 34,000 pounds and turns on a huge center pin which is keyed in a heavy casting, anchored securely to the concrete. The casting and the center pin weigh 13,000 pounds. The rim of the great master wheel is so heavy that its weight would break the spokes, and so it is supported in four places by rollers. One-half of this rim is cog geared. Through these it is revolved by an electric motor which drives a train of gears and pinions. These turn the rim of the wheel, which moves the connecting rod to the gate, causing the gate to open or close in two minutes. The action is just the reverse of the action of the connecting rod on the driving wheel of a locomotive. If the reader can picture a locomotive suspended in the air, and the driving wheel moved by power applied to the rim, the resulting movement of the connecting rod with the piston will represent in general outline the method by which the gate leaves are moved back and forth. The motor is remotely controlled by an operator stationed in the controlling house near the lower end of the upper locks, a simple pull of a small switch being sufficient either to close or open a 700-ton gate.

Elaborate precautions have been taken against accidents to the gate leaves. It is easy to see that this huge connecting rod, driven by the powerful master wheel, pushing the gate shut or pulling it open, would cause great damage in case the gate struck an obstruction, unless some method were devised to stop the machinery automatically. Such a method was devised and is in operation. At the gate end of the connecting rod there are two large nests of springs, one of which comes into play when the gate is being opened, and the other when the gate is being closed. These springs will bear a pressure of 60,000 pounds before compressing in the slightest degree, and a pressure of 134,000 pounds before breaking. In case a gate leaf is being closed, and a serious obstruction is encountered, one nest of springs will be compressed. When they reach a certain degree of compression a lever is automatically thrown which cuts off the electric power from the master wheel and stops it instantly. The opposite nest of springs acts in the same way when the gate strikes an obstruction on being opened.

The connecting rods and master wheels are so arranged that the greatest power is exerted when the most of it is needed. As a gate leaf is swung open it must force out the water in the V-shaped space between it and the lock wall, so that most power is needed just at that time. When

a gate swings back against its recess in the wall the angle of the connecting rod is such as to give it great leverage but slow motion. The same wise provision has been made for holding the gate in position when closed. At this point the connecting rod is practically on a dead center, so that any pressure that may be exerted on it does not tend to revolve the master wheel.

It may be imagined that without many sealing devices there would be openings between the gate leaves and between the gates, walls, and floors that would leave them anything but water tight. One of the devices in use is known as a miter-forcing machine. This consists of a mechanism placed on the end of one gate leaf, which reaches out and takes hold of an engaging part on the end of the opposite leaf, when the gates are in the act of closing. It forces the two leaves together and holds them in rigid contact so long as the gates are shut. In opening the gates it is necessary first to release this miter-forcing machine. On the floor of the lock is placed a heavy timber which comes in contact with very heavy rubber flaps four inches wide, on the bottom of the gate, thus making a perfect seal.

Around no other canal locks in the world have so many safeguards been thrown. In the first place, across the locks ahead of each gate, a huge chain, whose links are fashioned out of three-inch iron, is swung in such a way that any ship not stopping in due time will ram its nose into the chain and will be checked by it before any damage can be done. This chain will stop within 70 feet a 10,000-ton ship moving at the rate of five knots an hour. Each of these protective chains has a great hydraulic paying-out arrangement at either end, which is imbedded in the lock walls. The chain begins to pay out when the pressure reaches 100 tons. It will not break under a pressure of less than 262 tons. Each chain is 428 feet long, and its two ends are attached to big plungers in cylinders imbedded in the lock walls. There is a broad surface of water under each plunger from which small valves open up when a pressure of 750 pounds to the square inch is brought against them. The harder the pressure, the greater the amount of water let out and the greater the resulting speed of the paying-out apparatus. The chain pays out four feet for each foot of movement of the piston. The hydraulic arrangement of the chains practically makes them vast water buffers against the progress of the ship. The paying-out process is rapid enough to prevent any undue strain on the fender chains, and yet slow enough to stop the ship before it can do any harm. There are twenty-four of these fender chains across the locks, and their normal position is one of readiness to stop any ship which approaches the lock gates when it is not under thorough control. These chains are raised and lowered in about one minute. As there is always danger that a paying-out mechanism may be flooded, a unique automatic pump has been installed. A flood valve is in position always ready to turn on an electric switch, which starts the pump the minute the paying-out mechanism is threatened with such an overflow of water. As soon as the water is pumped out, the switch is turned back by the same automatic process, and the pump stopped.

It has been demonstrated that the majority of accidents in the operation of locks are caused by ships passing through them under their own power. A single misunderstood order or a single moment of hesitation in executing an order passed from the lock operator to the man in the engine room may result in disastrous consequences, and has so resulted upon many occasions in various locks. At Panama no ship will be allowed to pass through the locks under its own power. All vessels are required to come up to the guide walls, where they are taken in tow by electric towing engines. There are engines on each of the two walls of a lock chamber, and with ordinary ships





1. [illegible] on Seattle-Wenatchee [illegible] on Douglas Mountain of Cascades for passenger and [illegible] service. Tight curve at west approach for crossing
2. Bridge on Seattle line

two of these will be connected with the forward part of the ship by cables, while two other engines get behind to hold the vessel from moving too fast. In this way the average ship will have four engines attached to it by long cables, two for pulling it forward and two for preventing it from moving too fast, and they stop it exactly when a stop is desired. Each of these engines is provided with a windlass by which it may control a ship even when standing still. There are two tracks for these engines. The track used in towing a ship through the locks is a rack track to which the engine is geared. An ordinary railroad track is used for the towing locomotives when they run idle. These towing locomotives were built by the General Electric Company. The ones designed by the Canal Commission provided friction drums which would automatically permit the cable to pay out. It was found that these friction drums were unreliable, and they were discarded. Another trouble encountered with the first engine built was that the paying-out drum was too narrow, which caused the cable much injury in its operation. Still another difficulty was the jar caused by the uneven surface of the rack track, when the wheels which protected the locomotives from a side pull engaged it. This trouble was overcome by utilizing huge springs in a side-thrust-preventing mechanism. The solenoid brakes and friction clutches were substituted for hand brakes and clutches, and the windlass was made wider, so that the engine, as finally built, embodies the most approved ideas in towing locomotive design.

Another method of protecting the locks from injury is the provision of extra gates at every exposed position. These gates are seventy feet away from the operating gates. Should a ship, approaching the locks, by any chance break the big fender chain which is intended to stop it, the safety gates would next be rammed. These gates are even more securely mounted than the main operating gates, and the apex of the two leaves is turned in the direction from which the ship would come. It would take tremendous force to ram down a pair of these protective gates. Every precaution will be taken to stop ships before they reach the fender chains, and it is to be doubted whether one in a thousand would ram its nose into these chains. Likewise, it is to be doubted whether one in a thousand of those which did encounter the fender chains would break them, so that there is not one chance in a million that the protective gates will be rammed. And it is probably a thousand to one that no ship which had negotiated these defenses would break down the protective gates. Thus the possibility of ramming the operating gates is seen to be exceedingly remote.

But in their unprecedented spirit of precaution the designers of the locks have provided against even so remote a chance as that. At the head of each set of locks they have built an emergency dam with which they may close up the lock chambers with sheets of steel, in the event that all other precautions fail. These dams are huge cantilever pivot bridges, one of which is built on each side wall of a set of locks. When out of use the dam reposes on the wall, parallel with its longitudinal axis. When needed to close the channel it is swung across the lock by electricity. To the floor beams of the end of the bridge which goes across the lock, there are attached a series of six wicket girders.

One end of each of these girders is free, and by steel cables they may be raised or lowered singly or in series. When it is desired to use the dam, the bridge is swung across the channel, and the free end of the girders let down to the bottom of the lock, where they engage in an offset. These thus make a sort of inclined railway, down which huge steel plates are run on live roller bearings. There are six plates resting on each girder, and when they are all in position they make a solid steel dam extending from the bottom of the locks to

the floor of the bridge. Every precaution has been taken to make these dams efficient. The bridges are swung by electricity, and limit switches make certain that they will stop in exactly the right position. Electrically operated machinery drives the wedges which hold the bridge firmly in position. The emergency dams were made by the American Bridge Company, and each one had to be thoroughly tried out before it was accepted. It takes only a few minutes to swing the bridge across the channel, and not much longer to close up the channel with the steel-plated dam which swings down from the floor of the bridge to the floor of the locks. While all of the machinery of the emergency dams is operated by electricity, provision is made for their operation by hand in the event that they are needed in an emergency when no electric current is available. That these dams give efficient results is shown by experience at the Soo Canal. There a ship rammed the gates and started the waters flowing through the locks with destructive force. The emergency dam had been so long out of use that it could be operated only by hand. Yet with this difficulty, the Soo lock operators were able to check the flow of water in a very little while.

Every precaution has been taken to eliminate the personal equation in the operation of the locks at Panama. The man who operates a set of locks occupies a control house on the center wall of the upper flight of locks, thus giving him an unobstructed view of the whole series of locks with which he must deal. Further than this, he has a little model of the locks, and every result of his manipulation of the levers and switches stands out before him on the model in his office. When he opens the mighty gates of the locks, he also opens the gates of the little lock model; when he operates the valves in the water supply culverts, he also operates the valves of his little model. In this way he is able at all times to know exactly what he has been doing. Further than this, he cannot make a wrong movement even if he should be careless. His system of levers and buttons is an interlocking one, and he simply cannot do the wrong thing. For instance, he cannot let the water through the large culverts until the gates which are to control this water have first been set into position. Likewise, he cannot operate the gates until he has first set the fender chains in their proper position. In this way practically every chance of accident from carelessness is eliminated.

Having seen now what the locks are, let us return and look at them in the process of construction. In building them enough concrete was used to build a row of houses reaching from Chicago to St. Louis. Upward of five million barrels were used in constructing the locks, spillways, and dams. The stone for the locks on the Atlantic side was brought from Porto Bello; that used on the Pacific side was quarried at Ancon Hill. Two different types of material handling machines were used. On the Atlantic side the concrete was handled by huge Lidgerwood cableways. The towers of these cableways were 85 feet high, and they were set on the banks of the canal so that the cableways would span the set of locks. The cables consisted of two and a half inch lock steel wire. They were guaranteed to carry six tons at a trip and to make twenty trips an hour. Each cableway was guaranteed for a life of 60,000 trips.

A circular electric railroad connected the storage piles of sand, stone, and cement with the concrete mixing machinery. The material in the storage piles had been brought to Gatun in barges, the sand from Nombre de Dios, the stone from Porto Bello, and the cement from the docks at Colon. The sand and stone supply was unloaded upon the storage piles by cableways like those used in handling the concrete in building the locks. It was taken from these piles and loaded upon the little cars of the circular railway, in exactly the right proportions. Then the cars were sent on their way to the concrete mixers, which could deliver a mixed charge or receive an unmixed one without stopping. The

little cars on the circular railway ran without motormen. They had automatic governors that held them to a constant speed up hill and down, and when going down hill their motors were reversed into generators, thus making them furnish, in part, the current that lifted some other car over the incline.

After the concrete mixers had finished rolling around the stone, sand, cement, and water in their busy maws, they dumped the mixture out in big buckets mounted on little electric trains operated by a motorman on a third rail track. Each little train carried two buckets. One of them would pull up to the concrete mixers, receive its two bucketfuls of concrete, nearly six tons of it to the bucket, and then hasten away to a point under a Lidgerwood cableway. Here would come down out of the air two empty buckets, which would be set on the cars beside the two full ones. A little wigwagging served to place them properly, and then a little more wigwagging, and the full buckets were caught up into the air to the steel cableway where they struck a carrier that carried them across to the desired position over the locks. Here they were emptied and returned to be delivered to the next train that came along, in exchange for two other buckets filled with concrete.

On the Pacific side cranes were used in lieu of cableways, and dinkey steam locomotives instead of electric railways. One crane carried the materials to the concrete mixers, which turned over the concrete to the little trains, just as at Gatun. They conveyed it to the other crane, which lifted it up to the desired position, where it was dumped.

CHAPTER XXVII

HAMMERED DOWN UNIT-COSTS

Cost of Removing Material Reduced from Ninety-Eight Cents a Cubic Yard to Fifty-Four—Hampered by Slides—The Cost-Keeper's Sheet—Value of Rivalry—Establishment of a Newspaper—How it Differed from the De Lesseps Paper—Reports on the Performances of Steam Shovels—Three Divisions of Work, Atlantic, Pacific, Central—Rivalry in Economy—First Estimates of Probable Costs—The Saving in Cost of Concrete at Gatun $500,000—Saving in Concrete on Pacific Side of Canal $6,500,000—Porto Bello Quarry Stone Expensive—Comparison of Costs Before July 1, 1909, with Years that Followed—Lieutenant Colonel Gaillard at Culebra Cut—Value of Cost-Keeping System—Millions Saved Each Year—An Example of Public Efficiency—Canal Completed Years Ahead of Expectations.

IN 1908 it was estimated that the cost of removing the material from Culebra Cut would be ninety-eight cents a yard. By 1912 the cost had been forced down to fifty-four cents. The rigorous hammering down process applied in Culebra Cut saved Uncle Sam some fifty million dollars on the estimates of 1908. When those estimates were made, it was thought that there would be nothing but the straight-away removal of the spoil in place. Little was it dreamed that thirty million yards of material would slip and slide and break into the cut, necessitating not only its removal under great difficulties, but making more difficult the removal of the material naturally there. But that happened, and had not the engineers faced squarely the problems it involved, there would have been a vast deal of trouble at Panama, trouble that would have cost millions of dollars and involving years of delay.

It was a keen understanding of the value of rivalry among the workers that led Colonel Goethals to institute the cost-keeping system which he established at Panama. He wanted every man on the job to know just what he was doing and just what his colaborers were doing. He wanted comparisons made constantly—and on the isthmus, comparisons were not odious except to the man who fell behind in his work.

One of the valuable aids in reducing unit-costs was the canal newspaper. De Lesseps had a canal bulletin, which devoted much space to the great promoter himself and drew glowing pictures of achievements that existed only in the brains of those who were responsible for the bulletin. Goethals started a paper that showed records from week to week, thereby stirring up active rivalry among the men.

Each week, the *Canal Record* came out with a report upon the performance of the steam shovels. Every steam shovel crew sought to head the list and to go its own achievements one better. The competition for high records stirred the enthusiasm of the men to a remarkable degree. Of course, the shovel that got the week's record wanted to win the month's record; and the one that made the month's record tried to capture the year's record, and so there was incentive multiplied and intensified. It meant more cubic yards of dirt moving in a given time, the only extra cost being the added repairs to machinery and a little extra coal. The results of this campaign for steam shovel efficiency were gratifying in more ways than the saving of money. Every time a shovel took out a hundred yards more



1. Brig. Gen. Harry F. Hodges, designer of locks at Panama.
2. Dredging fleet entering locks at Gatun.
3. Dredge in lock chamber at Pedro Miguel.





1. View showing gates closed across a lock chamber and water welling up through the floor of the lock.
2. From large culvert at the right the water is conveyed through cross culverts under the lock floor, and thence through openings in the floor, as shown in No. 1.

than its estimated capacity in a given time, it hastened the completion of the big waterway, for Culebra Cut was the backbone of the work, just as Culebra Mountain was the backbone of the isthmus.

When Colonel Goethals installed the cost-keeping system under which he proposed to check up the work of every man on the canal, he was carrying out the same idea that had led to keen rivalry among the Atlantic, Central, and Pacific divisions. The Atlantic division he made a military organization. Every one of its responsible heads was a military man. The Pacific division was strictly a civilian's organization—not a man in it was an army man. The Central division was made up of a military head and civilian subordinate officials. Of course the army men on the Atlantic side were not willing that the civilians over the mountain should excel them, and, of course, the civilians on the Pacific side would not think of allowing the army folk across the Continental Divide to come out ahead of them if that could be avoided; so under the leadership of Sidney B. Williamson, they toiled as though their very lives depended on the job. Meanwhile, the Central division, having little work to do that was strictly comparable to the work in the other two divisions, desired above everything else to get its work as a whole finished before the other two divisions had finished. It is asserted that they would have finished their work first but for the slides which they had to combat. These slides threw them back more than two years.

After Colonel Goethals had given the force a year's try-out, he set to work, as stated in another chapter, to reduce unit costs. He wanted rivalry not only as to expedition, but as to economy, so he instituted a cost-keeping system. This system was not popular in some quarters, being referred to as "a kindergarten for accountants." It was suggested that it would cost as much to keep the cost-sheets as it would to do the work. But in spite of these criticisms, the cost-keeping system went into effect.

The first thing to be done was to estimate all probable unit-costs as the facts in hand then indicated they would be. Every piece of work from the breakwater in Limon Bay to the fill in Panama Bay was gone over, and the estimated cost, both as a whole and for its units, was fixed.

It was estimated at that time that the cost of the concrete work at Gatun would be $7.75 a cubic yard. The cost proved to be $7.46 a cubic yard, representing a saving of about half a million dollars in the concrete work on the locks.

The showing on the Pacific locks was very much more striking than that on the Atlantic locks. To begin with, the estimates of cost were higher by fifty cents a cubic yard, owing to the fact that on the Atlantic side, the three flights of locks were all together, while on the Pacific side, there was one flight at Pedro Miguel and two at Miraflores, necessitating the practical completion of the Pedro Miguel lock before the others could be started, and calling for a removal of the plant from the former place to the latter. Therefore, the estimates of the cost of the concrete on the Pacific side, in place, called for $8.25 a cubic yard. The actual cost at Pedro Miguel was $5.87 a cubic yard, approximately, a saving of $2.38 a cubic yard on 906,000 cubic yards of concrete. At Miraflores the cost was $5.34 a cubic yard, a saving of $2.91 a cubic yard on each of 1,476,895 cubic yards of concrete, plain and reinforced, put into the locks. The saving on concrete in the locks on the Pacific side was approximately six and a half million dollars.

The greater saving on the Pacific side over that on the Atlantic side is, in a measure, explained by the difference in the cost of sand and stone. The stone used at Gatun in 1911, an average year, cost $2.34 a cubic yard delivered at the storage bins, while that at Pedro Miguel and Miraflores cost 84½ cents a cubic yard.

The selection of Porto Bello quarry was

due to the wish of Lieutenant Colonel Sibert to have the entire work of the Atlantic division done under his charge. He believed he could get stone at Porto Bello as cheaply as it could be obtained at Ancon. This addition of about a dollar and a half a cubic yard to the cost of the concrete used made a heavy extra expense on the Atlantic side. For the fiscal year 1912, the cost of stone in storage at Gatun, compared with that at Pedro Miguel, was greater by $1.69 a cubic yard. If there be deducted from this the difference between the cost of transportation and the difference between plant arbitraries, the net difference was 52½ cents a cubic yard in favor of the Ancon quarry. Sand, on the Atlantic side of the isthmus, also cost much more than on the Pacific side. Here, again, a different story might have been told if all the sand had come from Chame. The added cost of transporting stone and sand from Miraflores to Gatun would have been very small as compared with the costs encountered in using stone from Porto Bello and sand from Nombre de Dios.

It is interesting to compare the costs of many kinds of work before July 1, 1909, with the cost during the years that followed. In the Atlantic division it was costing 67.3 cents a cubic yard to excavate material with steam shovels up to that date; by 1912, the cost had fallen to 63.6 cents. At Gatun spillway, the cost of plain concrete fell from $8.00 a cubic yard to $7.42. Dry filling at Gatun dam fell from 49.4 cents a cubic yard to 38.6 cents a yard. At Gatun locks, the cost of plain concrete in position fell from $7.79 a cubic yard before July 1, 1909, to $6.94 a cubic yard in 1913. Back-filling at Gatun fell from 58.56 cents a cubic yard in 1910 to 42.56 cents in 1913.

In the Central division, the average cost of excavating prior to July 1, 1909, had been $1.03. By 1912, the cubic yard cost was reduced to 54.62 cents. This achievement stands as a monument to the lamented Lieut. Col. D. Du Bose Gaillard, who died too soon to see his wonderful work in Culebra Cut completed. It seemed that he had a positive genius for lowering unit-costs after Colonel Goethals had pointed the way with his cost-keeping system. He bore cheerful testimony to the value of that system before a committee of Congress, saying that he spent a great deal of his time studying his cost sheets and trying to discover from them where economies could be effected. As difficulties multiplied, unit-costs went down. Although slides might come down like avalanches, they could never force up the unit-cost in Culebra Cut. They might even force the bed of the canal to rise, but still the unit-costs went down. Big diversion channel embankments might burst and flood the cut, steam shovels might be caught and overturned, dirt trains might be imprisoned, trackage facilities might be injured, but Nature could not stay that steady march of Colonel Gaillard's unit-costs down the scale. More rock was encountered as the cut deepened, longer hauls had to be made in the disposal of the spoil as the work progressed, there was less elbow room for manœuvering the digging army as the sloping sides of Culebra Cut narrowed, but still the unit-cost figures went down. It was a brilliant achievement, deserving to rank among the greatest feats in the history of engineering.

Enormous sums were saved to the United States by the successful application of the cost-keeping sheets to the problem of digging Culebra Cut. During the fiscal year 1910, it resulted in the saving of about $5,000,000; in 1911, it saved some $7,000,000; in 1912, it saved nearly $9,000,000, and in 1913, it saved upwards of $5,000,000. In 1908, it was costing 11½ cents a cubic yard to load material on the cars with steam shovels; in 1912, this unit-cost had fallen to less than 7 cents. In 1908, the expense of drilling and blasting was more than 14 cents a cubic yard; in 1912, it was less than 12 cents a cubic yard. In 1908, it was costing more than 18 cents a cubic

yard to haul spoil to the dumps, an average distance of about eight miles; in 1912, this expense had fallen to less than 14 cents a cubic yard, although in the meantime the average hauling distance had increased to twelve miles. It cost 13 cents a cubic yard to dump the material in 1908 as compared with less than 5 cents a cubic yard in 1912. One pound of dynamite in 1912 was made to do the work that had been done by two pounds in 1908. Such was the story all through the great work at Culebra. Every man's work was checked every month and he could see for himself how he stood in comparison with other men doing similar work. Commanding the Culebra brigade was a master of economy and efficiency, hammering away day by day at the unit-costs.

The Pacific division also effected economies. It drove the unit-costs of dry excavation with steam shovels down from $1.01 a cubic yard to 71 cents a cubic yard. The unit-costs of plain concrete fell from $6.67 to $6.03 at Pedro Miguel, and at Miraflores it fell from $8.11 to an average of $5.01 per cubic yard.

So it was with every part of the work. Studying cost-sheets as a doctor studies temperature and pulse records, analyzing expense tables as a chemist analyzes a compound, it was easy to see every bad symptom and easy to detect every element that tended to keep unit-costs from reaching a minimum. Here it was costing too much to operate a steam shovel; there it was costing too much to lay a yard of concrete; at another place a dynamite gang was not doing as well as another group. Here the repair bill for Lidgerwood cars was too high; there too much time was being taken by spoil trains in getting a load of dirt to the dumps and back again. When the steam shovel was not making a satisfactory showing, the reason for the inefficiency was ascertained and remedied; when the repair bills in the Lidgerwood dirt cars was too high, a way was found to better center the load and thus permit the increase of capacity of cars. When there was too much time consumed by the dirt trains in making a round trip, it was found that the cause was broken cables in the Lidgerwood unloading apparatus and broken couplers on the cars. A weak link, which would break just below the parting point of the cable, overcame one delay, and a bridle that would hold the cars together, even if the coupling parted, overcame the other difficulty.

It was a case of speeding up at one place, effecting an economy at another, and making an improvement somewhere else. Now it came in the shape of a request for a little more energy at this point, now it was to save a little cement by shaking the bags, and now the saving of lubricating oil by having an inspector on the job. A saving of $50,000 by shaking cement bags was no small item. Enginemen and steam shovel men were somewhat wasteful with their lubricating oil, and the bill was moving up into six figures. Colonel Goethals detailed a man to visit all the engines and steam shovels and see how the oil was used. Then he issued instructions that a certain type of engine should have a certain amount of oil and that this oil should be furnished in standard cases. The result was a saving of tens of thousands of dollars.

The result of this careful attention to detail was such remarkable efficiency in the removal of 174,000,000 cubic yards of material and in the laying of 4,000,000 cubic yards of concrete that, out of the saving effected, Colonel Goethals was able to finance the removal of 58,000,000 cubic yards of additional materials, and carry to victory the war against the slides, one of the mightiest battles that man ever waged against Nature.

It is a remarkable record, not only in the saving of money but in setting an example of public efficiency the like of which seldom has been seen and which never has been surpassed. It shows why the canal was completed years ahead of expectations.

CHAPTER XXVIII

THE CANAL ARMY

Inspiring Story of Human Achievement—Splendid Personnel—Built in Spite of Law of Congress Providing for Construction—Resignation of First Commission—Second Commission Resigns—Not the Fault of Members of Commissions—Revamping the System—The Executive Order that Pulled the Teeth of the Law—Americans a Fine Lot of Fellows—The Eliminating Process—Thousands came and Hundreds Stayed—Weighed in the Balance—Long Hours and Inconveniences—The Pay Train—The Canny Scotchman—Why Worry?—Well Paid for Work—The Labor Unions—The Eight-Hour Law—Continuing the Old Wage Scale—Settling the Strikes—Colonel Goethals Takes a Hand—Accumulating Days of Leave—The Man with the A-1 Record—Two Shifts—Keeping Men at Work as Elbow Room Decreases—American Brains, Foreign Brawn—The European Laborers—How They Lived—Full Pocketbooks Too Heavy to Carry Around—The British Negro—Politeness and Deference—The Races Separated—The "Gold Roll" and the "Silver Roll"—The Postoffice—Recruiting Agents—Help Constantly Changing—Spanish Laborers—Staying with the Job.

IN ALL the history of the race there is not to be found a more inspiring story of achievement that we find at Panama, and it is largely due to the splendid personnel and the wonderful *esprit de corps* of the men who made up the canal-digging force. Whether it was the higher official in the service or the lowest switch tender in the ranks, the individual efficiency was remarkably high.

The canal was brought to a successful culmination in spite of the law of Congress providing for its construction. That law provided that the canal should be dug by a commission of seven men. The first commission was made up in such a way that there were conflicting powers in which the governor, the chief engineer, and the chief sanitary officer had independent sway, each in his particular field. So seriously did this threaten to disrupt the whole work that President Roosevelt decided to ask for the resignation of the first commission and to appoint another in which authority should be centered in three of the seven members, these three being the chairman, the governor, and the chief engineer.

This scheme did not work much better than the one which preceded it. When the resignations of the members of the second commission were asked for President Roosevelt appointed his final commission, concentrating the offices of chairman and chief engineer in one man, but leaving the power of control in the seven members of the commission. The result was just about what one might expect if seven generals of equal authority were put in command of an army in the field. Yet this was the plan Congress had laid out, and upon which it insisted. Two commissions had split upon the rock of equal authority, two chief engineers had been driven away by it, and now a third commission was about to be split and a third chief engineer was about to be driven away.

President Roosevelt soon saw that it was not the fault of the men who made up the commission, for they were all men of big caliber and good qualifications. Rather,

it was the system, and the system he determined to revamp. He ordered the concentration of authority in the chairman and chief engineer. Congress had not repealed the law that threatened the third disruption of the canal organization, but President Roosevelt pulled the teeth of it by his executive order concentrating authority in one man. This order aroused a bitter feeling in some quarters, but it built the Panama Canal.

The Americans who worked under the commission were as fine a lot of men as ever were banded together in a great constructive work. Loyal to the core, each man was ready to make any sacrifice that the interests of the undertaking demanded. Hence the work could not but move forward with a swinging stride under their direction. They were the cream of a long process of elimination. Thousands came and hundreds stayed. It was a great place for trying out a man; the weakling soon lagged behind and was dropped out. Only the upstanding, right thinking, energetic and industrious man could make good in a country where the climate bored itself into the very soul of every individual and put the acid test upon his nerves, where diversions were few and occasions for homesickness many.

In the course of a year or two of selection there was a body of picked Americans on the isthmus—a lot of men who could defy the climate, who found surcease from the pangs of homesickness through keen interest in their work, who served in the canal army without a backward look and with an "onward" spirit, just as they might be expected to serve in an army called to the defense of the American flag.

There were about 5,000 Americans on the job at Panama. Every man among them worked as many hours and put himself to as many inconveniences as the exigencies of the situation demanded. They were at it early and late. The pay train, for example, had to be loaded early in order to get the force paid off in the three days scheduled, and that meant that the paymaster had to be up and at work at 4 o'clock in the morning. During the trip across the isthmus in the pay train, sixteen hundred pounds of gold and twenty-four tons of silver were handled, in payment for a single month's work.

Upon one occasion Commissioner Rousseau was going over the work on the Pacific terminals. He had seen one engineer after another, and finally came to J. A. Loulan, a canny Scotchman in charge of the Ancon quarry, of whom it had been said that "he can get more work out of a rock crusher than the man who made the machine." The night before a Jamaican negro hostler had knocked the chock from beneath the wheels of an engine and it had run down the steep incline, off the end of the rails, and had sunk waist deep into the soft earth. At 2 o'clock in the morning Loulan was called up on the telephone and advised of the mishap. At half past two he had a force of men on the scene and at work getting the engine back on the track. When the commissioner met him he was as full of the "go ahead" spirit as though he had had nine hours' sleep and never a trace of Jamaican indifference to worry him. It was remarked that he did not look like a man who had been the victim of such carelessness, and he replied:

"Oh, what's the use to worry? That does not pay. We got the engine back on the track again, our force was at work at the usual time, and that hostler will be more careful next time; so why worry?"

Why worry? That was the philosophy heard everywhere. A thousand and one difficulties could thrust themselves into the faces of the engineers, slides could pour into Culebra Cut, dirt trains could sink into the seas of mud, sentiment at home could distrust Gatun Dam, muckrakers could assail the feasibility of a lock canal, but still the force pushed forward, surmounting each difficulty as it arose and cheerfully disposing of it with the query, "Why worry?"

The question of labor unions was one which threatened to handicap the work on

the canal, but the firm hand of the chief engineer put an end to that issue. Careful to recognize every legitimate right of labor organizations, he reserved the right of final judgment in all matters pertaining to the building of the canal. He was glad to have the American workman given the benefit of the eight-hour law, and was a champion of the plan to pay the men wages and a half for their work. When the change from the construction organization to the permanent organization took place he came to Washington and appealed to Congress to continue the old wage scale until the last finishing touch was put on the work.

When strikes were threatened, Colonel Goethals said: "Gentlemen, decide for yourselves. Quit work if you want to. That is your right and privilege. But if you do so, remember that under no circumstances will you be reëmployed." He said this in such a way that they knew that he meant it. After the boiler-makers' strike of 1910, when some of the boiler-makers walked out because they did not get their wages raised from $5.20 to $6 a day, the jobs were filled and the strikers were told that the isthmus had no more work for them. There never was another strike among the Americans there.

As work on the canal slowed down the men were permitted to accumulate eighty-four days of leave to their credit, so that when they returned to the States they would have ample time, with pay, to look around for other work. Likewise, provision was made that when a man left the isthmus, the record made by him during his services on the canal could be taken from the commissioners' card index and a transcript furnished. A man who had made an A-1 record at Panama was certified as being entitled to be rated as "excellent," and the man who came back to the States with such a record had little trouble in obtaining work.

Another evidence of the interest of the chief engineer in his men came when the steam shovel work began to fall off in Culebra Cut, because of the lack of elbow room. Colonel Goethals ordered that the work be changed to a two-shift basis, and thus the men who would have been dismissed were able to continue work for many months, with no disadvantage to the government.

It was American brains that dug the Panama Canal, but the brawn of British subjects that did the work. Perhaps nine-tenths of all the West Indian labor came from British colonies of the Caribbean region. Jamaica and Barbados were the principal recruiting grounds. Usually the Barbadoan was found out on the canal itself, while the Jamaican preferred the lighter tasks around the hotels, the quartermaster's department, and such places.

When the negro began work on the isthmus he did not have much of a reputation for industry, and very little more for strength. He was accustomed to very light work, at the hardest, on his native heath, and when he got to Panama he found the pace a strenuous one. After a brief experience with the West Indian, Chief Engineer Stevens declared that he found that one Italian or one Spaniard could do the work of three negroes, and so it was decided that the wage scale should be fixed in proportion to the working qualities of the two races. The European laborer was paid twenty cents, gold, an hour for his work and the negro, ten cents an hour. The West Indian received ninety cents a day and had the choice of feeding and lodging himself or of being subsisted and quartered by the Canal Commission for twenty-seven cents a day.

The European laborer received $1.80 a day and was charged forty cents a day for subsistence. The rations furnished the negro were practically a counterpart of the United States field rations in quantity and quality, yet the negroes preferred, as a rule, their little thatched huts and their meagre diet to the barracks and the wholesome food of the West Indian kitchen. On the other hand, the Spaniards stuck to the government quarters and the govern-

ment mess halls. In both cases the Canal Commission sought to have their menus made up by cooks of the same nationality as the men and with due regard for the habits of diet of these men at home. The Spaniards patronized the commission quarters and the commission mess hall because they were so far away from home that their wives could not come with them. The West Indian could easily save up enough to provide five dollars for steerage passage for his wife, and so he chose his home and its freedom and companionship in preference to good food and sanitary quarters. His little yam patch, his bean plot and his chickens made him perfectly happy. It mattered not that he was underfed; this system permitted him to work when he wanted to and to loaf when he preferred. Colonel Goethals once said that if the West Indian negro were paid twice as much he would work only half as long, for a full pocketbook was too heavy for him to carry around. There were many exceptions to this rule, but for most of them there was a long rest after pay day.

The British negro is deeply religious and most respectful. He has no dreams of equality. He is polite and deferential and is generally liked. He reminds one of the good old-time "darky" of the South.

The races were separated at Panama about as carefully as they are in the South to-day. The separation was not on the basis of black and white, but on that of "gold" and "silver" employees. As all blacks were on the "silver" roll it amounted to segregation of races. On the labor trains there was a separation between the Spanish laborers and the negroes. Some cars were marked "for blacks only," and others "for European laborers only," but for the most part it was "gold" and "silver." This was the rule in the railroad stations and even in the postoffices. Sometimes negroes coming down from the States would go to the postoffice and to the "gold" window for their mail. The clerk would tell them to go around to the "silver" window. This they would protest against doing, but the clerk would turn a deaf ear to all their protests. They would threaten to take the matter up with the Washington government or carry it to the courts, and expose a hypocritical policy that would make a "Jim Crow" postal service in Panama while failing to do so in the States. But they still had to go to the "silver" window for their mail.

The negroes at first had to be secured by recruiting agents. They were fearful of the Panama Canal, remembering what had happened to their brethren in the days of the French. But after the first year or two the stories of prosperity that came back from Panama proved a strong drawing card, and nearly every negro in Barbados and Jamaica who could raise the price of a steerage passage, five dollars, sooner or later found himself on board a Colon-bound steamer. The recruiting service secured about 26,000 laborers before it closed its work. The commission then depended on the natural inflow of labor to supply its demands for brawn. Every year, thousands would return to the islands whence they came, and other thousands would be on hand to take their places.

The negro help was thus constantly changing, and more than half of the force changed each year. But the labor market was always well supplied. There was always an excess of arrivals over departures, the surplus in some years amounting to 20,000 men.

The Spanish laborers were the best and steadiest workers that ever came to the isthmus. The government was permitted to recruit them only on condition that it would pay them in gold and repatriate them when their tasks were ended. The Spaniard was a very hard worker, and saving of his shining yellow wages. He was the balance wheel of the labor situation, too. The negro knew he must make good, or the Spaniard would take his place.

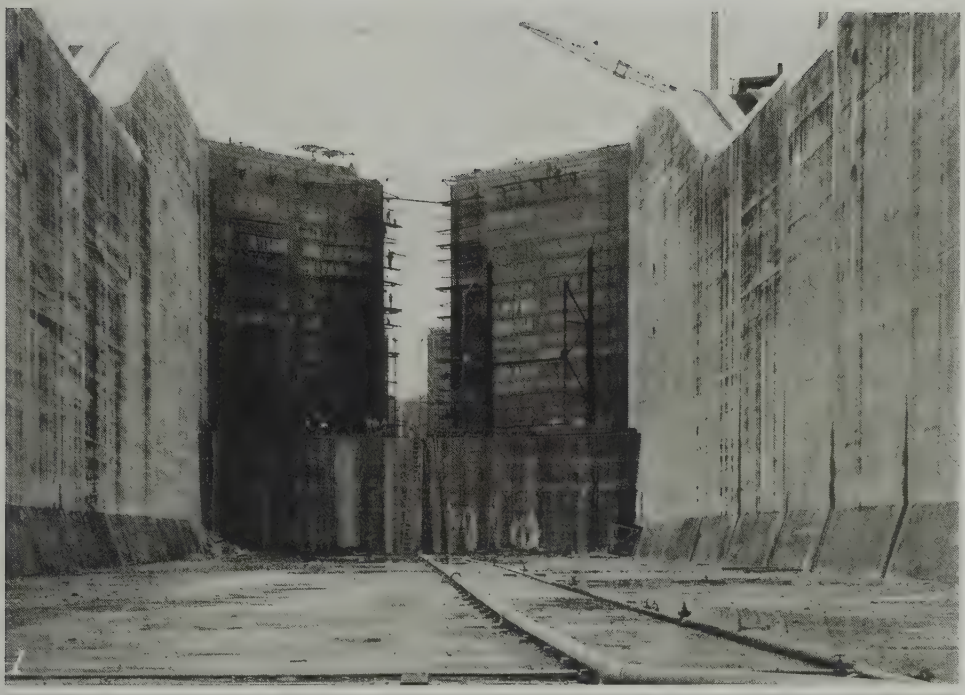
After the Spaniard had been on the isthmus for several years he began to grow

somewhat assertive of his rights as he construed them. When this condition reached a head, Colonel Goethals took a very decided stand. He told the Spaniards that he was through with their services under the terms of the agreement and was ready to send them home. He announced, however, that if any of them wanted to enter into a new contract with the government on the same terms as others, he would leave the way open for them to do so. They saw the situation and accepted the new conditions, with the result that they stuck to the job to the end and were able to go back home with enough money to make them independent for life, on the basis of their frugal method of living.

The United States owes a debt of gratitude to the men who bore the heat and burden of the great work of laying low the barrier that interposed itself between the oceans. When we think of the burning heat of the sun in the dry season, of the debilitating atmosphere of the wet season, of the tropical climate that caused clothes to mildew and shoes to turn green with mold overnight, a condition that kept up for nine months of the year, we may well imagine that the men who tugged and toiled day in and day out under such handicaps were made of sterling stuff.



1. Section of the centre wall of Pedro Miguel Lock in course of construction, with culvert built into it.
2. Framework of the same culvert, showing how the water is passed down through a gigantic gooseneck from one level to another.





1. One of the big gates nearing completion. From the bottom of the gate to the bottom of the floor below is 28⅓ feet, which represents one of the three lifts a ship gets on its way up from the sea to Gatun Lake.
2. One of the valves that control the water in the main culverts.

CHAPTER XXIX

QUARTERING AND FEEDING THE CANAL ARMY

FIGHTING HIGH PRICES—GOOD MANAGEMENT OF THE COMMISSARY AND SUBSISTENCE DEPARTMENTS—THE KIND AND CHARACTER OF THE FOOD SUPPLIED—PRAISE BY CONGRESSIONAL VISITORS—CHARACTER OF HOUSES SUPPLIED—JEALOUSY AMONG THE WOMEN—PROTESTS OF PANAMA MERCHANTS—ONE PRICE FOR CANAL EMPLOYEES AND ANOTHER FOR OUTSIDERS—THE GOVERNMENT MADE A SUBJECT OF EXTORTION—WORK OF THE COMMISSARY BAKERY—HOTELS AND BOARDING HOUSES RIVALS OF THOSE IN THE STATES.

IT is a military axiom that an army travels on its belly, and this might be applied to the canal army as well. And although one head of the commissary was disgraced for accepting gifts from people interested in contracts, that does not alter the fact that the commissary and subsistence departments rendered invaluable service and were instrumental in providing the people with all the necessaries of life at rates unprecedented in the retail trade.

Without the commissary and subsistence departments, the army would have had to face prices as high as the avarice of the natives could make them. With these departments they got supplies and food at prices that were usually lower than those made in price cutting sales by American department stores. The supplies were bought by the government at the lowest wholesale rates, and were sold to the people at the bare cost of handling. Clothing was much cheaper than in the United States. Foodstuffs could be bought at a bare margin over wholesale prices. Meats were good in quality and very cheap. If ever there was a kingdom around which a wall was built through which the barbarian High Price could not enter, it was the Canal Zone. Not only did this apply to the commissary, where supplies were bought, but to the subsistence department, where meals were provided. The West Indian negro got the equivalent of a United States army field ration at nine cents a meal; the Spaniard got the equivalent of a United States army garrison ration at thirteen and one-third cents a meal; the Americans in the I. C. C. dining rooms got the equivalent of modern American hotel fare for thirty cents a meal. United States Senators and members of Congress said meals were better than they could get in House and Senate restaurants at any price.

Let us take up in their order the three departments which had to do with the physical comfort of the people of Panama—the quartermaster's department, the commissary department, and the subsistence department.

The activities of the quartermaster's department covered many duties, chief among them the purchase of supplies and the maintenance of quarters. It also looked after the labor situation, the sanitation of the Canal Zone so far as it involved grass cutting and ditch digging, maintenance of the storehouses where the materials and supplies for the construction of the canal were kept, and the disposition of scrap. But we are concerned with the work of the quartermaster's department in providing homes for the people. There were divers and sundry types of houses provided. Some of these were family houses, in which the officials lived; some were two family houses, in which the lesser officials and Americans lived; some were four family houses, in which the American members of the force lived. All were screened in and all contained every necessary provision for comfort and health. There were quarters for the European laborers, and barracks for the negro laborers. The American bachelors

had a special type of house, a long row of rooms with verandas on two sides, with one or two men in each room. These quarters were light, airy, and cheerful, equipped with sufficient furniture to make them comfortable.

Married Americans were furnished with houses of such type as their position on the isthmus demanded. Applications for these houses were filed in the order of their receipt, and there was a constant waiting list for prospective vacancies. Sometimes bachelor quarters had to be fitted up for men and their wives while they waited for suitable houses. The women took their meals with their husbands at the I. C. C. hotels pending the opening of their own homes.

All houses were furnished by the government. The furnishings corresponded to the type of house, but all the houses were complete enough to make the ordinary family comfortable. There was freedom from the ordinary worries of the householder, for coal was furnished for cooking, and ice for the refrigerator. There were no electric light bills, no water rents to pay, and no drug stores accounts to meet. Free medical attendance was also provided, and the lot of the American on the isthmus was a happy one so far as the routine expenses of the householder were concerned.

But with all this the women of the Zone found frequent cause for jealousy. Miss Brown thought Mrs. Jones had better lighting facilities; Mrs. Smith thought Mrs. White was favored in the matter of bedsteads; and Mrs. Johnson was in possession of a vast amount of proof of discrimination against herself and her family. The district quartermasters had to practice the gentle art of diplomacy in such cases to so great a degree that it is certain that any one of them could now qualify for almost any diplomatic post.

The housing problem was met with satisfying results to everybody except the West Indian negro. The two family flat for Americans receiving from $200 to $300 may not have been quite as satisfactory as the six or seven room cottages, of which there were a few for this class, but on the whole the employees who lived in two family flats had little to complain of. Employees who received less than $200 a month lived in four family flats, which gave them all the comforts they could hope to get in like positions at home, and rent was free at Panama as against $300 a year at home.

The Spaniard was as happy and contented in his little bachelor quarters as the American married man in his house or flat, since the fact that he could send so much good American gold back to his people in Andalusia or Galicia made up for his absence from those he loved. The Spaniard's quarters were like those of the American bachelor, but on a largely reduced scale.

As to the negro, his quarters were barracks, with bunks that probably reminded him too much of the bunks in a prison cell. So it happened that although here he could have free quarters he greatly preferred a thatched hut in the "bush." And as tropical architecture is simple, he could provide for himself with no outlay except some work with a machete at odd moments for a week or so. Then he could invite his family from Jamaica or Barbados to the Canal Zone, which invitation was promptly accepted by wives, children, dogs, chickens, and all. So the commission quarters went begging, and not more than one-fifth of the negroes made use of them.

The commissary was one of the most effective of all the adjuncts of the canal building organization. When the United States started to build the canal it saw at once that if the canal army were not protected from the avaricious disposition of the tropical American, it would result in the demoralization of the forces. Therefore the commissary organization of the Panama railroad was utilized for supplying the canal army with its day-to-day needs. This protected the canal forces from the cut-throat prices in Panama, at the same time leaving the canal diggers free to buy where they could buy to the best advantage.

The Panama merchants protested energetically against the commissary, for they saw in the canal army a trade that would make them rich. But the canal authorities stood firm, and the commissary continued to the end. It finally came about that the native merchant made two prices, one for the canal employee and the other for the outsider. The canal employee was given a price in keeping with those at the commissary, else the native merchant could get none of this trade. The outsider did not have the privilege of buying at the commissary, and when he went to the native merchant he was charged "all the traffic would bear."

The rapacious character of local business is shown by the way the government fared on a number of occasions when the commissary supplies had to be replenished in the local markets. Once a ship bringing coffee to the commissary went aground and the commissary authorities ran short. They replenished their stock in the local wholesale market, but paid six cents a pound more for the coffee at wholesale than it had been selling for at retail before the ship went aground. At another time a vessel carrying milk failed to arrive and that commodity jumped to double its ordinary price over night. High waters in the Chagres River cut off the train service on the Panama Railroad at another time, and the price of ice ran up the scale from fifty cents a hundred pounds to one dollar a hundred pounds. In view of such instances as these, which occurred every time the commissary had to go out into the local market for its supplies, the United States is to be congratulated that Uncle Sam decided to play the rôle of merchant at Panama.

The main reason why the commissary was operated through the Panama Railroad rather than through the Canal Commission itself was because of the requirement that all moneys received by the Commission should be covered into the Treasury. With the railroad company it was different. It could turn its money over and over again without covering it into the Treasury or having it reappropriated. This enabled it to act as commissary keeper without the embarrassments which the Canal Commission would have encountered.

The commissary never sold on credit and yet never sold for cash. As it was established for the benefit of the employees only, the general public could not buy. Employees were furnished with coupon books which were paid for in cash if the employee had no wages coming to him, or charged against his account if he had already earned enough to pay for the book. When the pay roll was made up these amounts were deducted from his monthly pay. The commissary detached coupons from the books as purchases were made. An employee could buy a book and deposit it with the commissary storekeeper and then telephone his order if he desired to do so.

The commissary did a business of $7,000,000 a year during the construction period, and bought to good advantage because of the quantity handled. It was able to sell porterhouse steak for 20 cents a pound at a time when round steak was bringing 24 cents a pound in Washington. Round steak was 13 cents a pound, leg of lamb 20 cents, veal chops 24 cents, pork chops 18 cents, blue fish 15 cents, sugar cured ham 20 cents, cabbage 4 cents, white potatoes 3 cents. Everything else was equally cheap in price.

Every morning there went out of Colon a train carrying perishable supplies to the people along the line. This refrigerator train supplemented the work of the local commissary store which was to be found in every Zone settlement.

The commissary bakery baked over 6,000,000 loaves of bread a year, and about 200,000 pounds of cake. The commissary laundry washed nearly 4,000,000 pieces a year. The commissary ice cream freezer made over a hundred thousand pounds of ice cream a year, and the commissary egg testers tested over 30,000 eggs a day.

The subsistence department managed the hotels and boarding houses. There were eating places provided for all manners and conditions of men and grades and degrees of pocketbooks. First among these were the Tivoli and the Washington hotels, where one's fancy could be indulged to about the same extent as in a first class New York hotel. During 1912 the Tivoli cleared $53,000. Approximately 161,000 meals were served, the cost of food being fifty-one cents and the cost of service nineteen cents per meal.

The I. C. C. hotels were really restaurants serving meals only at the usual mealtime hours. The Americans employed in the Zone could get meals at these eating houses at thirty cents each, and the fare left nothing to be desired.

The line hotels served over 2,000,000 meals during the fiscal year 1912, at a loss of about $12,000. If a private contractor had held the contract and had made only two cents per meal, he would have been $40,000 ahead at the end of the year. The material composing each meal cost a little over twenty-five cents and the service one cent and six and one-half mills. On some days the attendance ran above 3,000, while the average was 2,000.

The European laborers' messes gave them rations at forty cents per day. There was, in 1912, a small profit made on these messes, and some writers, with money making instinct, have condemned this. But the service was worth all that was charged for it. The mess halls were large and airy, the men had cooks of their own nationality, and their appetites were catered to in every reasonable way. Nearly all the Europeans on the isthmus took their meals at the mess halls, and without exception acknowledged that never before had they known what it was to have such a liberal supply of food.

With the negroes there was difficulty. At first the Commission tried to compel them to get their meals at the West Indian kitchens. These kitchens appeared spotless in every respect. Everything was prepared in a very wholesome way. But in spite of this, and in spite of the fact that the United States was offering them the equivalent of a United States army field ration for twenty-seven cents a day, it was unsatisfactory to them, and they were finally allowed to subsist themselves. Many of them became weak from deficient nourishment and, therefore, could not do a full day's work, but even that was to be preferred to a continual shortage of negro labor.

On the whole, supplying the needs of the canal army in shelter, food, and raiment was a gigantic task in itself. It cost much to do it, but it was worth more than it cost; for the army, knowing that Uncle Sam was its shield and buckler against the high prices existing everywhere else in the world, was a contented and reasonably happy body of men, and never failed in its efforts to construct the canal in the shortest possible time.

CHAPTER XXX

LIVING CONDITIONS IN THE ZONE

LACK OF RATIONAL AMUSEMENTS A SERIOUS DRAWBACK—HOW COLONEL GOETHALS SOLVED THE DIFFICULTY—THE Y. M. C. A. TO THE RESCUE—CLUB HOUSES ESTABLISHED—A GREAT TEMPERANCE MOVEMENT—THEATRICALS AND MOVING PICTURES INTRODUCED—BASEBALL AND SPECIAL TRAINS—WOMEN'S CLUBS PROVE A GREAT FEATURE IN PROMOTING CONTENTMENT AMONG THE FEMALE RESIDENTS OF THE ZONE—SATURDAY NIGHT DANCES.

"OUR most serious handicap is the lack of rational amusements. The people have so few diversions that they soon yearn for their homes in the States, and that condition is followed by the loss of good men from our force." Thus spoke Colonel Goethals, upon one occasion, in discussing the needs of the great work. That was shortly after he took up the reins on the isthmus, and he was quick to meet the situation. Several Y. M. C. A. buildings had been built which were intended to serve as club houses for the men, but the plan had not been developed. New buildings were added at several places and a liberal policy adopted that made the Y. M. C. A. enter largely into the every-day lives of the men and women of the Canal Zone. The club houses were the meeting places of nearly all the organizations of Americans. Their large, spacious rooms were given over to a meeting of the women's club, or devoted to a dance or a concert, or became the scene of amateur or even professional theatricals.

The people liked the liberalized Y. M. C. A. idea, and the club houses were most beneficial. One of the first evidences of their usefulness was the falling off of liquor sales. Before they were built the men had no place of resort except the saloons. The men drank and kept drinking largely because there was nothing else to do.

This and many other causes made for discontent, and during the first two years over ninety per cent. of the Americans returned home each year.

It was perceived that if the work was to be a success the government itself would have to provide amusements for the men. Congress had made no specific appropriation for such a purpose, so President Roosevelt decided to build the club houses and discuss the matter with Congress later. But Congress never debated the subject. The good results were so obvious that there was no room for argument.

Each club house contained billiard rooms, an assembly room, a reading room, bowling alleys, dark rooms for the camera clubs, gymnastic equipment, an ice cream parlor and soda fountain, and a circulating library.

When these club houses were built drunkenness quickly fell into disrepute, and the saloon trade fell off at least sixty per cent. Men who had frequented the saloons could now be found at the club houses reading the latest paper from home, going through the new magazines, taking part in a game of billiards, or at work with their bowling teams.

The club houses were under the management of the Y. M. C. A. and trained men were put in charge, their salaries being paid by the Commission. How useful they made themselves in creating a spirit of contentedness, on the part of the American worker, is shown in the history of work accomplished.

The dues of the members were only ten dollars a year, and the operations annually left a deficit of about $7,000 at each of the larger club houses which was assumed by the Commission.

The activities of the Y. M. C. A. club houses are set forth in the annual report for 1912. It shows that during the year seven companies visited the Canal Zone from the United States, giving eighty-five entertainments, with a total attendance of 21,000; and 406 entertainments given by local talent and moving pictures scored a total attendance of 96,000. During the year the bowling alleys recorded a total of 104,000 games, and 278,000 games of pool and billiards were played. There was a total attendance of 15,000 at the gymnasium classes, while 420,000 books were withdrawn from the circulating libraries for home reading. Soft drinks, light lunches, and ice cream dispensed yielded a revenue of $60,000.

The Y. M. C. A. work was only a part of the general scheme of recreation. The commission maintained a band for the benefit of the people at an annual expense of about $12,000; band concerts were given regularly at various points, and special trains run for the benefit of employees and their families who desired to attend them.

Baseball made as strong an appeal to the American love of sport at Panama as ever it did at home, and the commission encouraged this in every way, furnishing grounds, special trains, and opportunities for practice; and no league ever fought out a more exciting series of contests than the isthmian league. Usually the pennant contenders were the teams of Empire and Culebra, and the whole isthmus became engrossed in their fight.

When the Americans first went to Panama there were few who took their wives and children with them. But after the yellow fever germ was exterminated and the malaria germ was denied admittance to the precincts of the isthmian home, men who had families in the States brought them to the isthmus, and the bachelors began to sigh, each for the girl he had left behind. The result was that there was soon a large number of American wives on the Canal Zone, and with nothing to occupy their minds they soon became the victims of discontent. Each woman thought every other woman was treated better than herself by the quartermaster and the commissary attendant, and the petty little annoyances that in a normal community would be laughed away, flourished there even as the vegetation of the untamed jungle.

To remedy this condition Miss Helen Vanck Boswell was invited to visit the isthmus to organize women's clubs. She went and was welcomed with enthusiasm by the women, who set to work with a will in all the affairs with which such clubs interest themselves. Their lonesomeness gave way to contentedness, and instead of dwelling upon fancied wrongs they developed a spirit of satisfaction at being able to help along the great work of building the canal by promoting the general welfare among both men and women.

The spirit of the commission in providing rational amusements and comforts for the people may be read in the statement that the cost of these accessories amounted to more than two and a half million dollars a year.

The Canal Commission provided good churches for both white and black, where ministers of any denomination could meet with their flocks, and several chaplains were employed at its expense to help with the religious work of the community. The negro churches were built so that the lower story could be used for worship and the upper story for lodge purposes.

The social life on the isthmus centered at the Hotel Tivoli, which was built with a spacious ballroom where the fortnightly Saturday night dances could be held. These dances were given under the auspices of the Tivoli Club, composed of representative Americans. The youth and beauty of the American contingent turned out in force at these functions.

During the latter years of the construction period the new Hotel Washington, with its ballroom opening three sides to the

sea, was opened, and on alternate Saturday nights dances were held there.

From time to time there was a word of criticism as to the liberality of the Canal Commission in providing rational diversion for the people who had to build the canal. With all that was done, however, fifty per cent. of the Americans still grew weary of the heat and the stress of the big task every year and went back to the States.

Life on the Canal Zone was all that a generous government could make it, and yet it was not one iota more pleasant or more profitable than was necessary to make it bearable to a sufficient number to enable the canal work to go forward in a satisfactory way.

CHAPTER XXXI

THE CANAL FORTIFICATIONS

Isthmian Topography Suited to Canal Fortification—The Atlantic Defenses—The Fortified Islands of the Pacific—Size and Character of the Armament—Danger of an Open Attack from the Sea Eliminated—Remarkable Search Light Equipment—Plenty of Reserve Ammunition—The Fire Control Station—The Troops Stationed on the Isthmus—Waters Suitable for Planting of Mines—Naming the Panama Forts—A Great Military Reservation—Locks in Little Danger—Right of the United States to Fortify the Canal.

THE topography of the terminal sections of the Panama Canal lends itself admirably to the purpose of the military engineers to whom was intrusted the task of making the canal impregnable against a sea attack. At the Atlantic side the entrance to Limon Bay is somewhat narrow, and the big guns mounted at Toro Point, on one side of the mouth of the canal, and at Margarita Island, on the other side, completely command this entrance from the sea. But this narrow opening from the Caribbean into Limon Bay has been made much narrower by the building of two great breakwaters, one extending out toward the canal for a distance of two miles, and the other being about a mile long on the opposite side, but not connected with the mainland. It reaches back, however, toward the mainland to shallow water, and any hostile ship which might seek entrance would be directly under the guns of Margarita Island. The powerful armament there protects the canal against any attack by sea, since no ship would expose itself to the terrific fire of the land batteries and the great mortars planted there.

At the Pacific end all the defenses are on the east side of the channel. Several islands, among them Naos, Flamenco, and Perico, are situated a little distance east of the Panama Bay section of the canal, and some three miles from the mainland. These islands rise precipitously out of the sea and afford excellent sites for heavy armament. They have been connected with the mainland by a breakwater built from Balboa to Naos Island. This island has been connected with Perico and Flamenco by stone causeways. A railroad and a driveway provide military communication between the mainland and the fortifications.

The heaviest armament at each end of the canal consists of a 16-inch gun. These are the largest weapons in possession of the United States, and perhaps the largest in the world. Each gun is fifty feet long and weighs 284,000 pounds. At an elevation of forty-five degrees the range is over twenty-four miles, but as mounted the range is something over eleven miles. The projectile is six feet long, weighing 2,400 pounds, and containing 140 pounds of high explosive. The charge is 670 pounds of smokeless powder, the explosion of which causes a pressure of 38,000 pounds per square inch. The muzzle velocity of the projectile is 2,250 feet per second, or 1,500 miles per hour, and the muzzle energy is 84,000 foot tons. The shell will penetrate any armor plate in existence at eleven miles range. At this distance the water line of a ship would be ninety feet below the horizon.

The secondary defenses on each side consist of six 14-inch guns, six 6-inch guns, sixteen 12-inch mortars, and eight 4 7/10-inch howitzers. The mortar shells have a range of 20,000 yards, or over eleven miles; each shell weighs from 700 to 1,046







DEFENSES OF THE CANAL

1. The 16-inch gun.
2. Type of 12-inch mortar.
3. Projectile of 16-inch gun, 6 feet long.
4. Firing a 12-inch disappearing gun.

pounds, and carries from 60 to 120 pounds of high explosive. At extreme range the shell reaches an altitude of over eight miles, its target being the deck of the hostile warship.

The small guns and howitzers will come into play only when an enemy approaches within a mile of the fortification and attempts to effect a landing. These howitzers may be moved from place to place to meet the needs of the mobile forces in case of attack by land. A battery of eight howitzers will be stationed permanently at Gatun locks. At both ends of the canal the twelve-inch mortars are so placed that they will be useful in repelling attacks by land as well as holding the enemy in check at sea. They will be able to sweep the country on the Atlantic side as far inland as Gatun locks, and on the Pacific side as far as the Miraflores locks. If called upon to take part in a land defense they will be loaded with shrapnel, a most effective weapon against field troops.

The guns of the permanent forts are all mounted on disappearing carriages of the very latest models known to military science, which were especially designed and put through a most exacting test before being adopted.

With the armament now in position at Panama, the authorities at Washington do not fear any open attack upon the fortifications. Such an attack would result in disabling so many battleships that no enemy could afford to take such a risk unless it had first met and defeated the United States navy.

Surprise attacks are guarded against by a complete searchlight equipment at the fortifications. There are 14 searchlights, each with a sixty-inch reflector, capable of sweeping the entire horizon. Each of these searchlights was built at a cost of more than $20,000, the mirror alone requiring a year for its construction. The lights are operated from electric plants independent of the main plants at Gatun and Miraflores. The guns, also, are operated by electricity generated at these independent stations. A supply of more than $2,000,000 worth of ammunition will be kept on the Isthmus at all times. Each sixteen-inch gun has a supply of seventy rounds of ammunition. The fourteen-inch guns, carrying a shell weighing 1,400 pounds, have approximately the same number of rounds. These guns use a 365-pound charge of smokeless powder, and their shells will pierce the best of armor at ten miles range.

The fire control stations by which the guns find the range of the enemy are as complete as those of any other fortress in the world. With lofty lookouts and the instrument known as the range finder, the approximate distance between the guns and the enemy may be readily determined.

The defenses at Panama are manned by twelve companies of coast defense troops. Quarters for eight companies have been established on the Naos Island dumps. Two other companies are quartered at Toro Point, and the remaining two at Margarita Island. These four companies on the Atlantic side will be reinforced by those from the Pacific side in case of need. There are also three regiments of infantry, one squadron of cavalry, and one battalion of artillery stationed on the Isthmus, for which permanent quarters cost approximately $3,000,000. In addition to the quarters provided for troops stationed on the canal, field works are provided for the accommodation of 20,000 extra troops which may be sent to the Isthmus in case of war. The works are in the form of barricaded positions, intrenchments, and protective breastworks of such design as to enable the troops to undergo a state of siege. These field works are placed principally around Gatun and Pedro Miguel. All buildings for the permanent forces on the Isthmus are constructed on the unit plan so that any necessary expansion may be easily made.

When it was decided to fortify the canal, it was generally agreed that the fortifications should be impregnable. The General Board believed that such fortifications

would be an invaluable aid in the transfer of a United States fleet from one ocean to the other in the face of an opposing fleet. It pointed out that guns mounted on shore are on an unsinkable and steady platform, where they can be provided with adequate protection and accurate range finding devices. The board suggested that the mere statement of these elementary facts was sufficient proof of the value of seacoast guns in protecting the fleet while passing out to engage a waiting hostile fleet.

The appropriations committee of Congress took much testimony on the question of fortifications and their adequacy. General Weaver, Chief of the Coast Artillery Division, testified that in his opinion the defenses of the canal would be entirely adequate. He remarked that the only doubts expressed had been as to the means for preventing an enemy from using Taboga Island as a base of attack on the Pacific fortification, but that he considered this a groundless fear, because the guns of the Pacific fortification would not only cover Taboga Island but the waters for some distance beyond it. The mortars and the sixteen-inch gun range nearly five miles beyond Taboga, and the fourteen-inch guns about three miles beyond.

In addition to the defense provided by permanent fortifications, the waters at both sides of the Isthmus can be defended by mines. Provision has been made for this method of defense.

The fortifications at both entrances were named in advance of construction by Secretary of War Stimson. The Toro Point forts and batteries were named in honor of General W. T. Sherman; those on Margarita Island, in honor of General W. F. Randolph; and those in Panama Bay in honor of General U. S. Grant and Dr. Amador, the first president of the Panama Republic.

Under the plan of government the whole Canal Zone is practically a military reservation. Only such settlements are allowed as are necessary for the operation of the canal, and the governor is practically a law unto himself, exercising surveillance over the canal. Many persons have expressed fears concerning the danger of the destruction of the locks by high explosives, secretly placed by one or two men. Colonel Goethals is not one of those who entertain such fears. In order to accomplish the destruction of the locks, it would be necessary to place the charge very carefully, and even in time of peace the canal operators and watchmen are always on guard. As to airships, they could do no serious harm unless they were able to drop a huge explosive directly behind a lock gate. Aërial navigation has not yet reached the degree of skill required for such accuracy of aim.

The right of the United States to fortify the canal was at first disputed, not only abroad, but by some Americans. The confusion of thought on this subject was caused, in part, by the ambiguous language of the first and second Hay-Pauncefote treaties. While the first treaty seemed to deny the right to fortify, which in part led to the amendment of the treaty by the Senate and its consequent rejection by Great Britain, the second treaty, now in effect, tacitly recognizes the right of the United States to erect fortifications. In the notes exchanged between the two governments Great Britain explicitly recognizes this right. The temper of Congress was such, however, that even if Great Britain had not recognized this right, the canal nevertheless would have been fortified, in the absence of any stipulation binding the United States to refrain from defending its own property.

CHAPTER XXXII

TERMINAL FACILITIES

Supplying Coal to Government Ships—Supplies for Commercial Vessels—Government Coal Plants at Each End of the Canal—Oil Storage Tanks—Barge and Lighter Service—Government Does Not Seek a Monopoly of the Coal Business—Balboa Dry Dock—Details of Its Operation—Cranes for Handling Canal Gates and Heavy Guns—Building the Foundations for the Permanent Structures—Commercial Wharves and Piers—Character of Cargo Handling Apparatus—Administration Building—The New City of Balboa—Breakwaters at the Termini of the Canal.

THE most ample and modern facilities are provided at the Panama Canal for transferring cargo from one ship to another and for fueling, docking and repairing. Under the Spooner Act the President was directed, among other things, "to construct such safe and commodious harbors at the termini of the said canal as shall be necessary for the safe and convenient use thereof." When the estimates of 1908, fixing the total cost of the canal at $375,000,000, were adopted, authorization was made for the construction of breakwaters, but nothing was provided for other harbor improvements or facilities. These facilities were supplied and operated by the Panama Railroad Company in connection with its commercial business.

It was early seen that the canal would require freight handling facilities of much greater extent than the Panama Railroad would be warranted in furnishing. As the months lengthened into years, after the estimates of 1908 had been made, it began to appear that such terminal facilities as had not been provided for could be built out of the savings that were resulting from efficiency in the construction of the canal itself. Specific legislation was contained in the Panama Canal Act of August 24, 1912, which authorized the President to "establish, maintain and operate, through the Panama Railroad or otherwise, dry docks, repair shops, yards, wharves, warehouses, storehouses, and other necessary facilities for providing coal and other materials, labor, repairs, and supplies of the Government of the United States, and incidentally for supplying such at a reasonable price to passing vessels."

The government intends to supply its own ships with coal and to keep enough on hand at all times to supply such ships of commerce as cannot replenish their bunkers at a reasonable cost from private dealers. For this purpose a coaling plant has been established at each end of the canal. The main plant is located at the Atlantic terminus, and has a normal capacity for handling and storing 200,000 tons of coal, with a possible increase to 300,000 tons. One hundred thousand tons of this will be stored under water. The plant is located at the north end of the island at Cristobal, which is connected with the mainland over a bascule bridge crossing the French canal, and connecting with the Panama Railroad. The subsidiary coaling plant is located at Balboa, on the outer end of the south approach wall of the big dry dock. It has a frontage of 500 feet especially adapted for discharging vessels, and a frontage of 500 feet with high level bunkers adapted for loading vessels and barges. This plant is capable of handling and storing 180,000 tons of coal, with a possible increase to 300,000 tons. In addition to coal, facilities are provided at both ends of the canal for

supplying ships and the canal with fuel oil, there being two tanks at each terminus, the four having a combined capacity of 160,000 barrels of oil. Like the coal-handling plants, the fuel oil plants may be enlarged as the business of the canal expands.

A great deal of coal will be handled by barges or lighters that can be brought up alongside vessels, and the canal is equipped with a large number of them, as well as with fuel oil and fresh water lighters. It is expected that a number of steel barges of large capacity that have been used by the commission will be available for transfer to this service. A barge capacity of 16,000 tons of coal has been recommended by the Navy Department for the Atlantic terminus and one of 8,000 tons for the Pacific terminus.

It is not the intention of the government to maintain a monopoly of the business of handling coal. It will lease to individuals coal space in its coal-storage basin, and will furnish them with a means of handling the coal at a pro rata cost. It will give them the benefit of all its coal-handling machinery, charging them no more for its use than the government itself must pay.

Docking facilities are found at both termini, but mainly at Balboa. The main dry dock is large enough to accommodate any vessel that can enter the canal through the locks. Its length is 1,000 feet, its depth over keel blocks thirty-five feet, and its entrance width is 110 feet. A suitable site was found under the protection of Sosa Hill, where it is safe from bombardment from the sea. The dock was founded on rock, and its walls are lined with concrete. Diamond borings taken over the entire area proved the rock to be solid.

The dock will open from the canal, and normally it will be closed by a pair of mitering gate leaves very similar to those used on the canal locks, and operated by machines similar to those operating the lock gates. On the dock floor a seat is provided for a floating caisson at a sufficient distance from the gate to enable it to be painted and repaired when the caisson is in place. The dock is filled by means of longitudinal culverts in the concrete side walls, communicating with the dock basin through openings in the dock floor at its intersection with the side walls. The flow of water is controlled by four metal valves operated by machinery. The time required for filling the dock at extreme high water is about twenty minutes. The plant for emptying it consists of four centrifugal pumps driven by electric motors. The diameter of the stream from these pumps is approximately fifty-four inches. The time required for completely emptying the dock by pumping will not exceed two hours and ten minutes, under which circumstances nearly 6,000,000 cubic feet of water must be removed from the great basin, with an average head of approximately twenty-two and a half feet.

For smaller vessels, an auxiliary dry dock is used, for which a foundation on similar hard rock was found. This small dock was built instead of the marine railway that was once planned as a part of the canal equipment.

In anticipation of probable requirements, it was decided that two floating cranes of largest size would be necessary to handle the lock and dock gate leaves. These cranes were planned also to meet the requirements of the Navy Department. They are capable of handling the heaviest guns and armament in connection with the canal fortifications, and, also, are available for handling heavy freight. Likewise they are useful in repairing commercial vessels as well as for wrecking service, either of a military or commercial nature. Each of these cranes consists of a large steel pontoon 150 feet long, eighty-eight feet wide, and sixteen feet three inches average depth. The power is "steam electric," steam being supplied by a Scotch machinery boiler. Electric energy is generated at 220 volts direct current by steam generators. The pontoon is not self-propelling,

but is fitted with a powerful steam capstan at each of the four corners for warping the crane into any desired position. The cranes are further fitted with suitable towing bits, cleats, and two 3,000-pound anchors, handled by steam.

All of the piers and quay walls are built on reinforced concrete caissons put down to solid rock. In making these caissons, a concrete mixing plant was mounted on a train of cars in order to permit its being moved from one spot to another. From this mixing plant the concrete was poured into the space between two circular shells, where it was allowed to harden. The shells were then removed, leaving a great section of reinforced concrete piping about eight feet in diameter and six feet long. The first shell of the caisson, which was ten feet in diameter, had its lower end equipped with a sharp steel shoe. As it cut down into the earth of its own weight, laborers inside removed the material from under the shoe, allowing it to sink deeper. The remaining sections were eight feet in diameter, which permitted the full weight of the upper sections to fall upon the one at the bottom. A jet of water was forced around the lower section as it sank down, which served to make its movement more rapid. At times the weight of the upper sections was sufficient to force the caisson rapidly down through the soft mud, while at other times material was encountered which required a pressure of twenty-five tons in addition to the weight of the imposed sections above to force it down, even very slowly. A stratum of material encountered twenty-five feet below the surface at one place yielded sulphuretted hydrogen gas, which affected the laborers' eyes so much that some of them were forced to go to the hospital. When the lower caisson reached bed rock it was firmly anchored there, while the sections above were tied together with heavy iron rods. After the entire caisson was in place, concrete reinforced with rod iron was put into the caisson, practically making it a reinforced concrete pile ten feet in diameter in its bottom section, and eight feet in diameter all the way up to the proper level above the surface of the ground.

The wharves and piers for commercial use at Cristobal are situated between Cristobal Point and the canal channel. They are of permanent construction, about 1,000 feet long and 209 feet wide, with 300-foot slips between the five piers for which room has been provided. On the Pacific side, the piers for commercial use are at Balboa, and are placed at right angles to the line of the canal with the ends of the piers about half a mile from the center of the canal channel.

The superstructure of the commercial piers and wharves consists of one-story steel sheds having a clear height of twenty-five feet. They are of fire-proof construction with reinforced material used at every point.

There was some delay in the provision of cargo handling appliances, since there was no certainty as to the amount or character of freight destined to Panama for transshipment. It was found that the best type of cargo machinery could not be determined upon until the amount and nature of the business passing through the canal were more definitely known.

Most of the permanent buildings of the canal are located at the Pacific end. All of them were built of concrete blocks and structural steel. The administration building is located on an eminence about seventy-five feet above the surrounding plain at the base of Ancon Hill. It is three stories high, with a frontage of 327 feet and a depth at the end wings of 182 feet. The surface of the concrete blocks is covered with cement stucco and the roof is covered with dark red vitreous tiling. There is a central rotunda forty-three feet in diameter around which the offices are grouped. The floor area, exclusive of halls, lavatories, stairways and elevator shafts, is 67,000 square feet. The cost of this building was $375,000.

Below the knoll on which the administration building stands there once was a

great marsh. This was filled in to an elevation of twenty-five feet above sea level by material from the site of the harbor works and from Culebra Cut. On this the white settlement has been established, with its public buildings, such as the post office, police station, fire station, hotel, lodge hall, schoolhouse, commissary store, church and Y. M. C. A. building. All these buildings are connected by a continuous arcade. There is also a baseball ground, a tennis court and a band stand. The dwellings are arranged to provide for one, two, three, and four families.

Perhaps the most beautiful site on the whole Isthmus overlooks the Balboa terminal. It is the elevated plateau made by cutting into the side of Ancon Hill for the stone used in building the Pacific locks. About 500 marines will be quartered here in barracks costing $40,000.

The filled area at Balboa dump, made by dumping 30,000,000 cubic yards of material from Culebra Cut into the shallow waters of the Pacific Ocean, provided a desirable site for the eight companies of coast artillery quartered at the Pacific end of the canal.

The terminal waters of the canal are well protected by breakwaters. At the Pacific terminal the Naos Island breakwater is three miles long. It lies nearly parallel with the canal from 900 to 2,700 feet east of the channel and rises from twenty to forty feet above mean sea-level. Its top width varies from fifty to 3,000 feet and it contains nearly 18,000,000 cubic yards of material brought from Culebra Cut. It serves the double purpose of giving dry land connection between the forts on Naos and her sister islands and the mainland, and protecting the mouth of the canal against the cross currents which otherwise would bring into it millions of cubic yards of silt. A railroad track and a driveway will extend along its crest from the mainland to the islands. More than five days were required to complete this breakwater.

At the Atlantic entrance there are two great breakwaters. The one from Toro Point is two miles long, with a top width of fifteen feet and a height above sea-level of ten feet. It contains nearly 3,000,000 cubic yards of rock, that for the core coming from the Toro Point quarries, and that for the armor from the Porto Bello quarries.

The other breakwater does not join the mainland. There is an opening of 2,000 feet between it and the one from Toro Point, through which ships will pass. This breakwater is intended to prevent the filling up of the canal channel by silt deposits. The cost of the two Atlantic breakwaters was about $11,000,000, of which $7,000,000 was expended on the big one at Toro Point.

The work of designing the terminal plants for the canal was in the hands of Civil Engineer H. H. Rousseau.

CHAPTER XXXIII

THE CANAL IN OPERATION

DREDGING IN CULEBRA CUT—MIRAFLORES DIKE BLOWN UP—DESTRUCTION OF GAMBOA DIKE—FIRST OPERATION OF THE LOCKS—DESPERATE BATTLE WITH CUCARACHA SLIDE—FIRST VESSELS THROUGH THE CANAL—PASSAGE OF THE "ANCON" FROM OCEAN TO OCEAN—THE CANAL OPENED TO COMMERCE—REPATRIATION OF LABORERS.

IN the summer of 1913, when the steam shovels were getting down to grade in Culebra Cut, the chairman and chief engineer began his plans for opening the canal. Already that stretch of the sea-level channel between Gatun and the sea was under water, and the major portion of the Pacific channel also was navigable. There was some water in the twenty-odd mile stretch between Gatun and Gamboa, but the nine-mile stretch between Gamboa and Pedro Miguel and the one-mile section between Pedro Miguel and Miraflores was dry.

A quantity of slide material and about 600,000 cubic yards of earth other than slide material was yet to be removed. Some of the engineers wished to keep the water out and finish Culebra Cut "in the dry." But several considerations led Colonel Goethals to pursue the opposite course. First of all was the fact that the date fixed for opening the canal was January 1, 1915, and he realized that if his operating force was to be organized and trained and the machinery put through the shaking-down process before that date, it was necessary to get the canal under water as soon as possible. Experience at Gatun also had indicated that the counteracting weight of water tended to hold slides in check, and it seemed wise to utilize this force at Culebra. Moreover, dredging had proven so much cheaper in handling such material as that still remaining in the cut that considerations of economy were on the side of putting the dry sections of the canal bed under water. The Secretary of War approved the recommendations of the chief engineer, and arrangements were perfected for blowing away the last barrier and carrying the waters of Gatun Lake into Culebra Cut.

While these arrangements were being perfected the last dry sections seaward from Miraflores and Gatun, respectively, were being put under water. On Sunday, August 31, the last dike that barred the sea from Miraflores was blown up. Great well drills had bored 541 holes in the dike, and in these holes was tamped home 37,000 pounds of high percentage dynamite. A tiny creek, possessing the pretentious name Rio Grande, was dammed, and its waters were forced to flow into the big ditch between the dike and the Miraflores locks. By the time the day arrived for blowing up the dike, the creek had carried enough water into the section of the canal inland from the dike to protect the lock gates when the barrier was destroyed.

All the plans for the explosion were under the direction of Division Engineer H. O. Cole, an expert in such work. He had so perfectly proportioned the amount of dynamite to the task it was to perform that the barrier was shattered exactly as desired. After the gigantic explosion, which was attended by very little noise, a man with a shovel went out on the dike and dug a trench across the loosened earth of the crest. A tiny stream of sea-water, for it was high tide, began flowing through the trench. Forty minutes later the trench had broadened to a gap thirty feet wide, and a torrent of water was madly leaping down the dike and rushing toward the locks. One hour and twenty-five minutes

after the tiny stream trickled through the trench there was an opening in the dike 400 feet wide, and the water had filled up the channel to sea-level.

About the same time, suction dredges were set to work eating away the last barrier that shut out Gatun from the sea.

Steam shovel operations ceased in Culebra Cut September 10. The last steam shovels working on the bottom were No. 204, manned by H. S. Hayes and A. E. Alexander; and No. 226, manned by Albert H. Geddes and W. I. Hudson. They dug their last dipperfuls of earth about 10:30 A. M., and immediately thereafter the last of the quarter of a million dirt trains that had run out of Culebra Cut, in charge of Engineer E. C. Bean and Conductor E. A. Donnelly, was drawn out by faithful old engine No. 260. For another day steam shovel No. 210 remained in the cut, at the toe of Cucaracha slide, fighting an unequal battle to keep the tracks clear.

With the end of the dry excavation work came the clearing up of the cut. On schedule time all was in readiness for turning water in on October 1. Four two-foot pipes extending through the Gamboa dike from Gatun Lake into Culebra Cut were opened on that date, and water began to fill in the section of the cut between the dike and Cucaracha at the rate of about 1.6 feet a day.

October 10 was the date set for blowing up Gamboa dike, which had served a long time both as a barrier against the waters of the Chagres River and as an embankment over which the trains of the Panama Railroad crossed the canal. The dike had been drilled full of holes, a third of which had received charges of dynamite. A cable connection through Galveston was established between the White House and Gamboa, and when President Wilson pressed a button at the White House it closed a circuit at Gamboa. This tripped a weight attached to the handle of a switch, throwing the switch and firing the enormous blast. Half an hour later a cayuco, or native canoe, passed through the gap.

The locks were ready for operation before water was admitted to Culebra Cut. Indeed, the Gatun locks were operated for the first time two weeks before water communication was established between Gatun Lake and Culebra Cut. On Friday, Sept. 26, the sea-going tug *Gatun* presented herself as a candidate for the honor of being the first vessel to be lifted from the level of the Atlantic Ocean to the level of Gatun Lake. Hundreds of persons had gathered to witness the performance. When the water in the lower lock was brought to sea-level, the *Gatun*, with flags flying and whistles blowing, steamed into it, amid the resounding cheers of the onlookers. With the lock mechanism working perfectly, the tug was lifted up its three successive steps, twenty-eight and one-third feet each, and brought to the level of Gatun Lake. The next day she was let down again with equal success.

The day before Gamboa dike was blown up a number of dredges were lifted up from the sea to Gatun Lake, to begin the final act in the conquest of Culebra Cut. The Miraflores locks were first tried on October 14, and here, also, all the gloomy forebodings as to unwieldy gates and the like were quickly dispelled. The Pedro Miguel locks were ready for their tryout at the same time, but they had to await a water supply from Culebra Cut, which could be provided only when the engineers were able sufficiently to master Cucaracha slide as to permit the waters of Gatun Lake to pass by.

Cucaracha fought a very grim battle. The engineers tried to blast away the end of its toe, so that the water could creep past, along the west bank of the cut. A ton and a half of dynamite had no effect, and successive smaller blasts were fruitless of results. Dynamiting was then abandoned, and men with shovels working day and night, in eight-hour shifts, were set to digging a trench. Hydraulic sluicing was also tried, but it was a disappointment. Then blasting was resumed, with a charge





1. Culebra Cut.
2. Steamer Ancon passing through Culebra Cut.



1. Stretch of the canal near Empire after excavation work was completed.
2. Same section after the water was turned in.

of dynamite so heavy that the explosion shook the houses for miles up and down the canal, in many cases throwing articles from shelves as though there had been an earthquake. Still Cucaracha was unconquered. At last it was decided to bring a pipe-line suction dredge and pump water across the slide. A freshet in the Chagres helped matters considerably, and a few days later the water in the section of the cut between Cucaracha and Pedro Miguel became deep enough to permit the use of the locks at the latter place. This enabled the dredging fleet on the Pacific side to come to the spot, as those of the Atlantic side had done, and Cucaracha, attacked on its front, rear, and both flanks, began to yield.

As the water rose in Gatun Lake it was found that two saddles or depressions between the hills bordering the lake were so low as to present the possibility of overflow. The surface at the lowest point at the Cano saddle was 87.4 feet above sea-level—about the height of the normal high-water-mark in the lake. It was decided to build embankments along the crests of the saddles, which would bring them up to the same height as Gatun Dam. The fill at Cano is 900 feet long, 15 feet wide at the top, and 45 feet at the base. The other saddle, half a mile east of Gatun, needed filling for a distance of only 350 feet.

The first steam vessel to pass through the canal from end to end under its own power was the crane-boat *Alex. LeValley*, belonging to the dredging fleet. It had come up from Cristobal and was engaged at work in Culebra Cut. On the morning of January 7, 1914, it was sent to the Pacific entrance, thus completing the first full transit of the Isthmian highway by a steam vessel.

January 27, 1914, was an important date in canal history. On that day President Wilson signed the executive order putting into effect the reorganization of the canal government, to become effective April 1. Two days later Colonel George W. Goethals was appointed the first governor of the Panama Canal.

The first handling of a ship by the towing locomotives was on April 1, 1914. May 9 witnessed the first operation of the automatic control board, which makes it next to impossible for a lock operator to fall into error. The board has a system of indicators which shows the position of every important part of the lock mechanism throughout the operation. Little lock gates, drawn to scale, move over a blue marble slab representing the water in the lock chamber. The valves that open the culverts in the side and center walls are represented by a shutter moving up and down behind a glass screen, and the water level is shown in tubes on a scale of one inch to the foot. The operator is forced by an interlocking system to perform in proper sequence each act required to send a vessel through the locks.

The first commercial business handled by the canal was a shipload of sugar from Hawaii. The American-Hawaiian steamship *Alaskan* could not use the Tehuantepec route for the transfer of its cargo, on account of the war in Mexico, so it went to Balboa instead. There it was met by the tug *Mariner*, with several barges in tow. The tug and its tow left Cristobal at 6 A. M. on May 19th, reaching Balboa at 6:40 that evening. This was the first continuous ocean-to-ocean trip through the Panama Canal by any vessel. The entire 12,300-ton cargo of the *Alaskan* was thereupon lightered through the canal by the *Mariner*.

On August 15, 1914, the canal officially opened for commerce. On that day at 7:10 A. M., according to a prearranged schedule, the *Ancon*, one of the big cement-carrying steamers of construction days, left her berth at Cristobal with about 200 distinguished guests aboard, and in nine hours and forty minutes completed the passage from sea to sea.

The cablegram which Secretary of War Garrison sent to Colonel Goethals upon the successful passage of the *Ancon* found an echo in every American heart. It was as follows:

"On behalf of the government and the people of the United States I express to you and through you to all concerned in the achievement, the intense gratification and pride experienced today. By the successful passage of vessels through the canal the dream of the centuries has become a reality. Its stupendous undertaking has been finally accomplished, and a perpetual memorial to the genius and enterprise of our people has been created. The fully earned and deserved congratulations of a grateful people go out to you and your colaborers."

The canal was now formally open, and ships in unexpected numbers began to come. The honor of being the first war vessel to go through the canal fell to the little torpedo boat destroyer *Teniente Rodriguez*, of the Peruvian navy, which was returning to home waters from the Amazon.

The first foreign vessel to go through the canal was the *Daldorch*, a cargo steamer carrying wheat from Tacoma, Wash., to England. The *Daldorch* had intended to sail around South America, but was ordered to go through the canal, owing to the outbreak of the European war. She passed through the canal on August 22, and saved about forty days at sea thereby.

The battle with Cucaracha slide continued through the summer of 1914. There were dredges of all sizes and descriptions at work. Among them were the fifteen-yard dipper dredges *Gamboa* and *Paraiso*, gathering up from twenty to thirty tons of of material at a dipperful; the ladder dredge *Corozal*, with its endless chain, carrying fifty-two buckets, each large enough to hold twelve men; and a number of suction dredges handling twenty-inch streams of liquefied mud. These dredges made and kept the channel clear.

On the 14th of October, 1914, however, a new menace put in its appearance. Three-quarters of a million cubic yards of material came sliding down into the cut north of Cucaracha, making a rear attack on the dredging fleet. Fortunately the fleet saw what was coming and quickly drew back from Cucaracha far enough to get north of the new slide. Timely action saved the day, and in less than a week the traffic that had been interrupted was restored.

During 1914 the great task of repatriating the common laborers that had built the canal was carried forward. In sixteen months the net emigration from the Isthmus was 20,400. Among these emigrants were more than 16,000 actual workers on the canal. The common laborers who desired to return home were sent at the expense of the United States. However, many thousands of the West Indian negroes went to the banana plantations of the United Fruit Company, where they are now employed.

CHAPTER XXXIV

THE CANAL GOVERNMENT

EARLY FRICTION WITH NATIVE GOVERNMENTS—UNITED STATES ACQUIRES SOVEREIGN POWERS—CONFLICT BETWEEN CIVIL ADMINISTRATION AND CANAL ENGINEERS—CIVIL GOVERNOR'S POWERS CURTAILED—SELF-GOVERNMENT OF THE CANAL ZONE PROPOSED—CONGRESS PROVIDES PERMANENT GOVERNMENT WITH A GOVERNOR EXERCISING UNUSUAL AUTHORITY—SCOPE AND PLAN OF THE PERMANENT GOVERNMENT OF THE PANAMA CANAL.

THERE were four forms of government in the Canal Zone during the ten years from April, 1904, to April, 1914. Of these, three forms of government have been tried since American occupation in 1904.

When the Americans went to Panama, there was no separate government over what is now the Canal Zone. The French had been sorely handicapped by the fact that they were nothing more than a corporation operating in the republic of Colombia, and amenable to the civil and military rule of that country. They were under the direct rule of the province of Panama and the indirect rule of the Bogotá government. Whenever either of these governments wanted any favors from the French Company, their police and other powers over the canal strip were used in such a way as to enforce compliance with their demands.

When the United States undertook the work, the first requisite was full control of the territory. The treaty, therefore, granted to the United States sovereign powers over a five-mile strip on either side of the center line of the canal, reaching from one side of the isthmus to the other, but excepting the cities of Panama and Colon. Coupled with this exception, however, was a provision that the United States should always retain sanitary control of these cities, one the capital and the other the second port of the republic. A further provision granted to the United States the right to preserve order in these cities whenever necessary.

The history of the construction period shows the wisdom of those who thus profited by the experience of the French with the Colombian government. The Panamans were friends of the work, and realized its importance, alike to the United States and to Panama. But in their zeal to promote their own immediate interests they were sometimes led to lose sight of more important concerns.

The first government which the United States set up on the isthmus was administered by a governor appointed by the President of the United States. It was a civil government financed and operated by the United States and ruled by one of its officials. The population paid no taxes and had no voice in the government. The governor of the Canal Zone was a member of the Canal Commission, but he was independent of that body to a great extent in administering civil affairs.

As might have been expected, with the government of the Canal Zone largely independent of the commission, friction soon began to develop. The engineers wanted all matters of civil government considered with prime reference to the welfare of the construction work, and when it appeared that this was not being done there was a protest. The result was that not a great many months passed before there was a new form of government—one in which the administrator was not a governor, but merely a member of the Canal Commission, heading the department of civil administration.

In this way the Canal Zone was ruled

during most of the construction period. The arrangement worked very well. It is true that there was once a head of the department, who, after having been on the isthmus for many months, addressed a body of engineers, telling them that the day was soon to dawn when "the Atlantic and the Pacific would mingle their waters in Gatun Lake"; and it is also true that there was once a head of that department who inspired hostile attacks upon the man who had been commissioned to build the waterway. But in spite of occasional incompetence the system of government devised for the Canal Zone was successful.

Under this civil government were placed the postal establishment, the court system, the police and fire departments, the customs service, the roads, the schools, the prisons, and other matters of lesser importance. The United States built the water and sewerage systems of Panama and Colon under an agreement that it should be repaid in water rents covering a period of fifty years, and the cost of paving the streets of the two cities was to be repaid in ten years. The Canal Zone government was the collector of these funds. The head of the department of civil administration received $14,000 a year for his services.

When the time came to determine the character of a permanent government of the zone, it was proposed by some legislators that the strip should be thrown open to settlement, and that the little colony should possess the right of local self-government. They supposed that the country could be made a prosperous farming community and they minimized the military necessities and strategic value of the canal.

Fortunately Congress turned a deaf ear to these proposals. It realized that the commission plan had been a failure, and that the canal had been successfully built only by the concentration of virtually the whole power of government in the hands of one man. Moreover, a populated Canal Zone would have required large expenditures for sanitation and health preservation. A glance at the cost sheets of the canal reveals the fact that Uncle Sam spent nearly $17,000,000 for health purposes at Panama during the first ten years of American occupation. This expenditure included, of course, the cost of hospitals and free medical attendance for the employees of the canal and a few other items, such as employment of chaplains and the disposal of the dead.

Congress not only decided against a commission form of government for the Panama Canal, but it went to the opposite extreme and provided a one-man government of the strongest type, subordinating the governor of the canal only to the President and the laws; and it gave the canal authorities the right to declare the zone practically one great military reservation.

The law for the permanent government of the canal ratified and confirmed all executive orders as valid and binding until Congress should determine otherwise. This provision included the famous executive order concentrating the powers of the Canal Commission in the chairman and chief engineer. After Mr. Wilson came into office, some of the members of the commission thought it an opportunity to change the organization on the canal and secure an equal voice in its affairs. They were ready to carry their fight to the White House when their attention was called to this provision. It is barely possible that there might have been a third chief engineer going the way of Wallace and Stevens but for that paragraph.

The law provides that the President shall govern and operate the canal through a governor and such other persons as he may deem competent to assist that official. Upon the recommendation of Colonel Goethals, the salary of the governor was fixed at $10,000 a year. He had built the canal on a salary of $15,000 a year, while his predecessors had received $25,000 and $30,000 respectively. Yet he modestly suggested that his salary was as large as he was entitled to ask for, and he discouraged a movement to have the salary

of the governor fixed at $15,000 a year while he was the incumbent.

The governor of the Panama Canal is given jurisdiction and control over the civil government, with power to appoint magistrates, constables and notaries, to make rules touching the right of any person to remain on the Canal Zone, and to exercise other unusual functions.

The law significantly provides that when war exists or is imminent, the President shall designate an officer of the United States army to assume and exercise exclusive jurisdiction over the canal and the Canal Zone. It was this provision that saved the canal from having its military character entirely subordinated to its commercial uses. It had been almost decided to place the canal in control of a civilian under the Department of Commerce. As the law stands, the canal is under the War Department; and, while the canal will be operated for commercial purposes in normal times, it will always be kept ready for the fateful day which every American hopes may never dawn, but for which the nation dares not be unprepared.

In carrying out the law providing for the permanent government of the Panama Canal, President Wilson, on January 24, 1914, nominated George W. Goethals as first governor of the canal. He was confirmed February 4, and the new government went into operation April 1.

Colonel Goethals had urged that the change from the construction government to the operative government should be made in such a way as to cause the least possible friction. He proposed that the change should be an evolution, and that the persons who had "made good" during the construction work should be preferred in filling positions under the new régime. And he practiced, when he became governor, what he had preached when he was at the head of the commission. He promptly assured the people on the Canal Zone that the new government was to be a development of the old, an adaptation of the existing organization to meet the new needs.

The new government, in its details, is based upon an executive order issued by President Wilson, January 27, 1914, and embodying the recommendations of the head of the commission. The Governor is in supreme control, subject to the supervision of the Secretary of War. A Department of Operation and Maintenance is provided for, which has charge of the completion of the canal, and its operation, including the operation of the terminal facilities. The Purchasing Department is charged with the purchase of all supplies, which are turned over to the Supply Department. The latter department, also, has charge of the maintenance of commissaries, hotels and messes; it assigns quarters, maintains the buildings of the zone, and recruits and distributes the unskilled labor for the canal. The Accounting Department, under the immediate supervision of the auditor, has charge of all accounting work. A Health Department succeeds the Department of Sanitation. It takes over the operation of the quarantine service, the sanitary control of the Canal Zone, the sanitary relations between the United States and the cities of Panama and Colon under the treaty, and the operation of the hospitals and charitable institutions. The position of executive secretary is created, and he is given the administration of all those affairs which formerly were administered by the head of the Department of Civil Administration. He has charge of the time-keeping system in force on the canal; of all matters relating to post offices, customs, taxes and excises, except the collection of moneys; of police, prisons, fire protection service, schools, libraries, clubs and the land office. The files and records of the canal are under his supervision, as are, also, matters pending between the canal and the Panama government. He has custody of the official seal of the canal.

Later executive orders established a

Washington office, laid down the plan for the organization of the new judiciary, provided rules for the collection of tolls and the operation of the terminal facilities, etc.

When the work of reorganization began, it was carried out with the purpose of causing the least inconvenience to those who had to leave the isthmus on account of the gradual closing-down of the construction work. Employees were permitted to accumulate eighty-four days leave to their credit, and silver employees were repatriated at the expense of the canal. By the first of January, 1915, affairs had been placed on a permanent basis; the new judiciary system was in operation; and Governor Goethals had begun to look forward to the day when he could pronounce the canal finished and in successful operation.

On March 4, 1915, the President responded to the desire of the American people by recognizing the right of Colonel Goethals and his principal lieutenants to receive substantial promotion as a reward for their labors. The President nominated Colonel Goethals to be a major-general; Brigadier-General Gorgas to be a major-general; Colonel Harry F. Hodges to be a brigadier-general; Lieutenant-Colonel William L. Sibert to be a brigadier-general; and Civil Engineer Harry H. Rousseau was raised to the rank of a rear-admiral of the Navy. The Senate confirmed these nominations on the same day—a signal honor.

CHAPTER XXXV

BUILDING THE FOUNDATIONS

How Mr. Wallace Became Chief Engineer—Scope of Jurisdiction—Sanitation of Panama and Colon—Providing Living Quarters—Overhauling French Equipment—Cost-Keeping System Installed—Plans for Securing Labor—Explorations at Bohio and Gatun—Mr. Wallace Favors a Sea-Level Canal—Reorganization of Commission—Why a Lock Canal Was Selected—Yellow Fever Epidemic—Society at Panama—Friction over Labor Supply—How Coöperation of Panama Railroad Was Secured—Excessive Railroad Rates—Civil Service Restrictions—Foundations for Canal Finally Laid—Mr. Wallace Resigns.

By John F. Wallace.

THE first intimation I had of my name being considered in connection with the position of chief engineer of the Panama Canal was the following letter which I received from Mr. William Barclay Parsons:

At Sea, between Cuba and Colon,
April 3, 1904.

My dear Mr. Wallace:

On this trip from New York to the Isthmus the Commission has been giving earnest consideration to the selection of a chief engineer, realizing that a very great measure of our success will depend on that official.

The man for this position must possess exceptional qualifications. He must not only be an engineer, but must also be an administrator and executive. He must have mature judgment, and yet energy of accomplishment. He must be well known and favorably known. Among those who have been considered as so qualified naturally your name occurs, and the Commission desires to know whether if a tender of this position were made, it would be seriously considered by you. Owing to a previous professional engagement with the British Government I will be obliged to leave Panama in advance of the other members of the Commission and will arrive in New York on April 19th so as to sail for England on April 26th. The other members of the Commission and I would very much like to have you and me to meet to talk this matter over so that I could communicate with them prior to my leaving for Europe. Would it be possible for you to be in New York some time between the dates mentioned, on say the 21st or 22d of April? If you can do this we can discuss the whole thing and I can give an answer to my associates.

I can imagine that you will be disinclined to think of severing your connection with the Illinois Central, but on the other hand you would attach your name to the greatest piece of construction ever undertaken.

Hoping that you will be able to meet me, I am,
Yours sincerely,
William Barclay Parsons.

Pursuant to the suggestion of Mr. Parsons, I had an interview with him in New York, in which he explained to me the desire of the other members of the Isthmian Canal Commission as well as himself to secure my services as the principal representative of the commission on the isthmus, in full charge of all matters connected with the construction of the canal, with the title of chief engineer.

Mr. Parsons stated that as the commission was charged with the responsibility for the construction of the canal under the direction of the President, and as it was necessary for the commission, the duties of which would be largely administrative and legislative, to keep in close touch with the President and the legal, financial, and executive departments of the Government, it was thought wise at a recent meeting of the commission on the isthmus to put the actual execution of the work under the charge of an administrator with the title of chief engineer, in order to obtain that prompt action, unity of purpose, and efficient execution which could only be accomplished through a single executive whose authority under and responsibility

to the Isthmian Canal Commission should be properly balanced.

Mr. Parsons explained that on taking an informal ballot I had been the choice of such a large majority of the commissioners that it was decided to consider me for the position; and on account of his having to go to Europe he had left the isthmus a week earlier than the commission and had been delegated to take the matter up with me in a preliminary way and find out if I would be willing to confer with Admiral Walker and the commission on the subject upon their return to the City of Washington.

On the following Wednesday, May 4th, I visited Washington and had a conference with Admiral Walker and the commission, in which the communication made to me by Mr. Parsons was confirmed and the further explanation made that it desired not only the services of a technical engineer, but an administrator and executive with engineering knowledge and experience, preferring a man of my type and qualifications familiar with business methods used in the conduct of large enterprises, rather than to select an engineer who might have better technical qualifications alone.

At this meeting I did not accept the position, but outlined my views in regard to the authority that should be delegated to me and my responsibilities to the work, and laid particular stress on the fact that I could not give satisfactory service unless I was given an absolutely free hand in the conduct of the work; that I could not be expected to take orders or instructions from any individual member of the commission, but that the commission should decide matters of policy and organization relating to the general plan and conduct of the work, and its instructions should come to me, through the chairman, in the form of resolutions passed by the commission, and that my communication with the commission should be through Admiral Walker, its chairman.

In connection with my employment I want to say that Admiral Walker took particular pains to state that my tenure of office and obligations in undertaking the work were as outlined in a letter of instructions on this point which President Roosevelt had communicated to the commission, from which I quote the following:

"I believe that each one of you will serve not merely with entire fidelity, but with the utmost efficiency. If at any time I feel that any one of you is not rendering the best service which it is possible to secure, I shall feel called upon to disregard alike my feelings for the man and the man's own feelings, and forthwith to substitute for him on the Commission some other man whom I deem capable of rendering better service.

"Moreover, I shall expect if at any time any one of you feel that the work is too exhausting and engrossing for him to do in the best possible manner that he will of his own accord inform me in order that I may replace him by some man who to the requisite ability joins the will and the strength to give all the effort needed. But so long as you render efficient service of the highest type in the work you are appointed to perform you may rest assured of my hearty support and backing in every way.

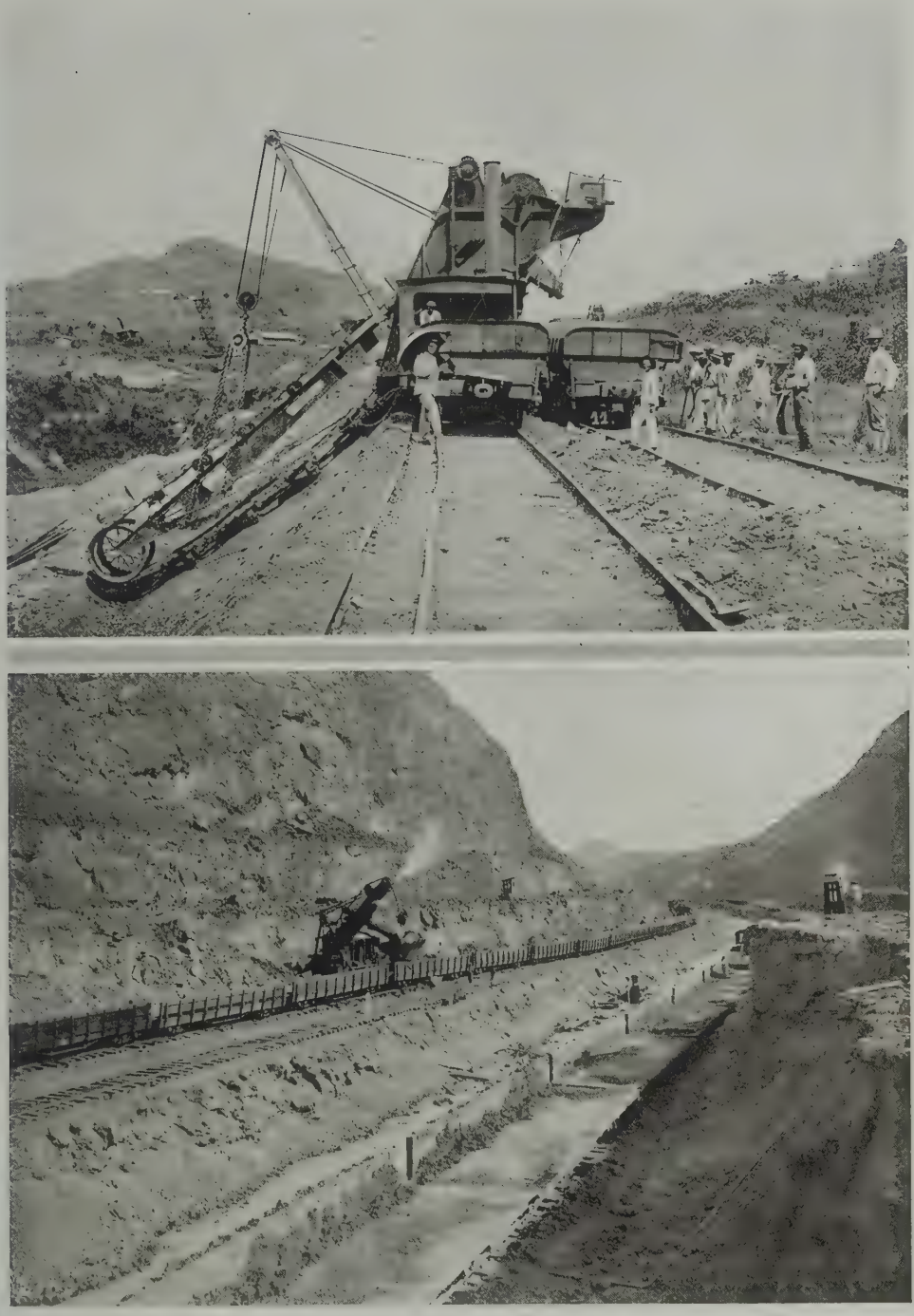
"These are the conditions under which you have been appointed and under which I shall expect you to proceed. I shall furthermore expect you to apply precisely the same principles in the choice and retention of the subordinates who do the work under you as I have applied to your choice and shall apply in your retention."

The admiral particularly impressed upon my mind the fact that no tenure of office could be conferred upon me by the commission except under the conditions mentioned in the President's letter above quoted, and that at any time I felt I could not perform my duties in harmony with the policy of the administration, or for any reason felt that I could not fully support that policy, the obligation rested upon me to resign, in which views I fully concurred.





1. Belgian locomotives used by French, and still serviceable.
2. Old French dredge.



1. In the days of the French.
2. Culebra Cut in the latter days of the Americans.

Upon my arrival on the isthmus I immediately placed Mr. Carleton E. Davis in charge of all work connected with water supply, sewerage, street paving, and other physical work necessary to be carried on in connection with such plans for sanitation as the commission might adopt as the result of recommendations of Colonel Gorgas and myself, it being understood that the chief engineer should have charge of the physical execution of the larger sanitary work and that Colonel Gorgas's department should have charge of the sanitary policing and such other sanitary work as could be conducted directly by and under his department. On account of the prevalence of yellow fever on the isthmus at this time, preparation for proper health protection was considered essential and paramount.

In this connection, it was necessary that an abundance of pure water should be provided for the various towns and settlements along the line, proper sewerage systems established, and in Panama and Colon that the streets should be properly paved.

Within three weeks after my arrival on the isthmus a general scheme for a water supply at Panama was devised, and Engineer Davis and his staff, under my general directions, immediately set to work and prepared plans for the water supply for Panama and for Colon, also a sewerage system for Panama as well as street paving.

A site for a reservoir was selected west of the Panama Railroad line in the vicinity of Culebra Cut, and an old reservoir which had been constructed under the French was enlarged and plans made for a secondary reservoir in the immediate outskirts of Panama. During August complete plans and specifications for the water supply were submitted to the Isthmian Canal Commission for approval.

This was followed by plans for a sewerage system, and for the street paving of Panama.

As soon as the plans were approved by the commission actual construction commenced, and all of the work with the exception of the street paving, the material for which had not arrived, was practically completed during my administration.

General Davis, Colonel Gorgas, and myself all considered these sanitary works as fundamentally essential to enable Colonel Gorgas to eliminate the plague of mosquitoes, which the medical department considered to be the chief, if not the sole method of yellow fever transmission.

Coincident with these works, Colonel Gorgas with a force under his immediate direction, started an extensive campaign of fumigation, the draining of marshes, cleaning up of vegetation, and other means for the elimination of mosquitoes.

The importance of the water works, however, consisted in the fact that the principal supply of water during the dry season, in both Panama and Colon, was provided through the storage of rain water in cisterns, most of which occupied the interior courts of residences and business houses. In these reservoirs the species of mosquito which transmitted yellow fever was constantly breeding, and the elimination of these mosquitoes was impossible as long as these cisterns were maintained.

At that time Panama had absolutely no sewerage except a few individual sewers that emptied directly into the harbor, and a sewerage system could not be established and made efficient without an abundance of water supply to flush the same. Again, the sanitary department found it very difficult to keep the streets free from accumulations of filth and garbage without a smooth surface that could be readily cleaned and flushed with an abundance of water.

It may be of interest to note that while I was assured by the authorities in Washington that my requisitions would be promptly filled for the water and sewer pipe necessary to make this installation—which could have been made within ninety days after the receipt of the material, and might have prevented the series of epidemics which occurred during the fol-

lowing dry season—they were not filled in a way that enabled the principal water main to be laid and put in use until some eight months later.

One of the first difficulties which I met in the initial organization was the fact that it was necessary to provide suitable and sanitary living quarters for the men before any large force was brought on the isthmus. It was a difficult matter to properly adjust the relation between the new forces necessary to start the initial organization in various parts of the work, and also to prepare sanitary quarters for the men who were brought to the isthmus to perform this service.

A building department was at once organized and put in charge of Mr. M. O. Johnson, with a staff of building mechanics necessary to rebuild the French quarters and to provide new quarters.

Under his supervision the hotel at Corozal was planned and constructed and also the one at Culebra, and a large number of buildings for quarters for the various officers, members of the staffs and the employees of all grades.

Another difficulty encountered was the inability to get requisitions filled for the proper wire netting which the sanitary department considered necessary to protect the men from the attacks of mosquitoes.

Here it might be well to mention that at Colon and Panama it was necessary to protect the employees from yellow fever mosquitoes, whose radius of action was small and which seldom went beyond the boundaries of the houses in which they bred, and in the outlying districts between Panama and Colon, as well as in Panama and Colon, to protect them from the kind of mosquitoes which transmitted malaria, which was considered by the sanitary department as fully as important as protection from the yellow fever mosquitoes, the malarial mosquitoes having a larger radius of movement and invading the settlements from their adjoining breeding places in the swamps.

It was not until several successive epidemics of yellow fever had occurred that the authorities at Washington finally awoke to the fact that our requisitions for the material necessary for these preventive measures must be fully and promptly filled, the great pressure from Washington on the chief engineer being to commence active operations in the actual excavation of material, due to the constant clamor of the American press to "make the dirt fly."

The first construction operations that were undertaken were at Culebra. We had come into possession of a large amount of machinery used by the French company, —dredges, excavators of various types, steam locomotives, dump cars, and all sorts of construction appliances and apparatus. It was the desire of the commission to experiment sufficiently with this material to determine its economic efficiency or inefficiency before finally adopting or discarding it.

As it was impossible to provide the work with entire new equipment before active operations commenced and as it was desirable to gradually train and build up a force, the work of excavation was at first carried along upon the lines followed by the French company, utilizing the native labor then available and gradually organizing the work and engaging American superintendents and foremen, in order that they might be trained to the utilization of such labor as was available and become acclimated and familiar with the conditions that were to be contended with.

At the start I devised a system of cost keeping in order to get a standard of comparison that would enable me to gauge the results of the various men and collections of men, the preference as to methods of handling work, and the efficiency of different kinds of machinery. Therefore, all costs were reduced to a cubic yard basis and costs were carefully kept of every detail of operation—the cost of explosives, cost of loosening and excavating material, cost of loading, cost of transportation, cost of disposition, and the cost of all the

various elements of supervision and the maintenance of equipment, track and appliances, on the basis of the cubic yard.

This method, amplified, improved and extended, I understand has been carried on throughout the entire work.

This system enabled me to gauge the results of all the elements, both personal and material, connected with the work, and to determine the relative efficiency of the different kinds of French appliances with each other as well as with American machinery and appliances, which were later installed after their superior efficiency was determined.

After a few months of experimental work the data accumulated enabled me to decide on the superiority of the modern American steam shovel, the use of American flat and dump cars, the adoption of the American railroad method of unloading by machinery, also the employment of machinery for the spreading of banks, and so on.

Specifications for machinery were prepared on these lines and large orders placed therefor in the United States, but delivery was slow and but a small portion was delivered for some months after I left the work. The slowness in getting requisitions approved and material furnished, as the result of cumbersome governmental methods in vogue, seriously hampered the preparatory work.

These data also enabled me to determine the relative economy of hauling excavated material short distances up steep gradients to nearby dumping grounds as against the long haul with low gradients to distant dumping grounds, and also as to the relative value and economy of spreading over wide areas and dumping from low heights, as against concentrating the excavated material for high dump disposition.

Various other important factors in regard to economic efficiency were developed by this system of costs. Where the experimental work was carried on at a high unit-cost, the information obtained was valuable in showing what not to do and what appliances and methods were uneconomical as compared with others which were more economical.

Even in regard to such minor matters as the construction rail furnished by the French company, which came in very short lengths on the theory that these short lengths were easily handled in the construction of temporary tracks, our experience developed that the American practice of using rails thirty feet or more in length, on account of their greater flexibility and the ease with which they would take the necessary curvature in being temporarily shifted from one position to another, as against the short kinks made by the stiff rails used by the French, due to their short length, and the diminished derailments resulting therefrom, finally justified us in discarding the use of the short French rails.

The same thing applied to the various dump cars, locomotives, dredges and excavators that had been used by the French company.

These preliminary operations, while not large in quantity, enabled us to shape up the work in such a way as to render the operations afterward carried on more economical and efficient. They also enabled me to gauge the rate at which excavation could be carried on by the different units of machinery and the various operating organizations, and were the basis of estimates which were later made as to the cost and time required to complete the work.

During this period the force at Culebra was gradually increased and organized and eventually became the basis of the expanded organization which was afterward used by my successors. All of this preliminary and experimental work had a much greater value than that expressed by either the quantities of material removed or the cost thereof.

In the meantime the work of providing quarters for men and building up and strengthening and getting a balance between the various departments of the work,

was carried on. Also the work engaged in by various parties of engineers to determine the character of the stratification and the geological formation under the route of the canal, and to outline the watershed of the Chagres and tributary valleys, was very essential and important in order to arrive at final determinations that had to be made in connection with the plans.

When I first took charge of the work on the isthmus I had no other thought in mind than simply the carrying out of the plans as outlined by the original Walker Commission, upon the estimates of which the Spooner Bill was based, which provided the authority and the appropriations for the construction of the canal.

The essential feature of this plan was an intermediate lake confined above Bohio by a dam at that point, at which the bed rock was supposed to be approximately 118 or 120 feet below sea level, the elevation of this lake to be about 90 feet above sea level, to be approached as in the plan finally adopted by three locks of approximately 30 feet lift on each side of the summit lake.

Extensive diamond drill borings at Bohio developed the fact that bed rock at Bohio was 168 feet below sea level instead of 118 or 120 feet as shown by the original borings made under the first Walker Commission, and that next to the bed rock was a continuous bed of open sand and gravel through which there was a constant flow of sub-surface water.

In considering alternate plans for this work my attention was next directed to a paper published by Mr. Charles Ward, which proposed a dam at Gatun, the site finally adopted by the Isthmian Canal Commission. I, therefore, caused extensive borings to be taken at the site of this dam.

I found two sub-surface gorges at this point, which had evidently been scoured out during past ages, one of which extended some 250 feet below sea level and the other 200 feet below. The contents of these gorges were sand, gravel, clay and quicksand, and all sorts of detritus, at various depths, in which there seemed to be a free movement of water.

The plan of Mr. Ward, provided a proper foundation could have been found for the Gatun dam, presented some very attractive features. One was that his elevation of sixty feet above sea level seemed to me to provide the most economical level and the best division between the expense of construction of locks and dams and the excavation of the summit cut.

Finding that the bed rock gradually sloped from an unknown depth at Colon to at least 250 feet below sea level at Gatun and 168 feet at Bohio, and to approximately sea level at Gamboa, I finally came to the conclusion that I could not consistently recommend to the commission any plan which would involve the construction of either locks or dams or other structures, foundations for which could not be carried down to bed rock, or which would permit a flow of water below the foundations of the structures, which might create difficulties that at some future time would be disastrous to the enterprise.

Based on this conclusion, which I considered fundamental, I gradually came to a state of mind in which I was inclined to recommend that no plan be adopted that could not be eventually transformed into a sea-level canal, provided the future demands of traffic and future conditions should justify it, but as I realized the complications that such a recommendation would make and the controversies that would ultimately grow out of it, I refrained from transmitting my views to the commission until February, 1905, when three members of the commission, consisting of Governor Davis, Mr. Wm. Barclay Parsons, and Professor Wm. H. Burr, were appointed a committee to take the matter up with me on the isthmus and obtain from me a definite report and recommendations.

At this time my views were crystallizing upon the construction of a dam at Gamboa, where the foundations could be carried

to solid rock in a practical manner and at reasonable cost, and the creation of a lock canal having an elevation of approximately sixty feet above sea level, fed by a lake to be confined by the dam above Gamboa.

However, realizing that several years of work could be carried on in the excavation of the cut at Culebra and in other preparatory work, and that no time would be lost by reserving a decision as to the final type of canal, I was averse to making any positive recommendations to the commission until our surveys, examinations and experimental work had been carried on to such a point as to enable sufficient data to be obtained so that a wise decision could be finally reached.

On account of the large amount of excavation necessary to be performed at Culebra which would be common to any and all plans, I did not consider that this line of policy would in any way retard or delay the completion of the canal under any plan that might thereafter be adopted.

The committee of the commission above referred to returned to Washington, and, based more on the facts gathered by it while on the isthmus through my instrumentality than on the views or recommendations expressed in the preliminary reports and estimates which I made to the committee, recommended the construction of a sea-level canal.

Within a few weeks after the commission made their recommendation to the President through the Secretary of War, the members thereof, with the exception of Major Benjamin M. Harrod, were removed and a new commission created, with Mr. Theodore P. Shonts as chairman, and of which I was made a member. Mr. Charles E. Magoon was also appointed on this commission and was made governor of the Canal Zone, and Chairman Shonts, Goverernor Magoon, and myself constituted the executive committee, to which was delegated the full powers of the commission.

On account of the reorganization necessitated by the appointment of a new commission, I was temporarily recalled to the States, and while in Washington was called into conference by General Peter C. Hains and General Oswald H. Ernst, new members of the commission, who endeavored to draw out my ideas in regard to the final plan and tried to impress upon me the necessity of not recommending any plan that would require any change in the Spooner Act, which was the basic authority under which the work was being carried on and which contemplated a lock canal and the use of an intermediate artificial lake.

It might be well here to refer to some earlier history, in order to explain how the plan of an intermediate lake came to be originally considered in connection with the project.

It will be remembered that when the first Walker Commission was formed it was for the purpose of considering the most feasible of the various canal routes across the isthmus, and that the two principal competitive routes at that time were the Nicaragua route, which was backed by what was known as the Maritime Canal Company, and the Panama route, which the French Company controlling it desired to dispose of to the United States Government.

The controlling feature of the Nicaragua route consisted of a natural lake about ninety or ninety-five feet above sea level, which necessarily had to be approached by two sea-level sections with a series of locks on both the Pacific and Caribbean slopes.

It was suggested to the Walker Commission that in order to make a proper comparison between the Panama and Nicaragua routes and to place the two enterprises upon the same basis, some plan should be adopted that would enable the estimates to be made with some degree of parallelism.

Out of this grew the conception of the creation of an artificial lake at Panama, at approximately the same level as the natural lake at Nicaragua, in order to place the two enterprises on an equivalent basis, the same unit prices being used for excavation and for the construction of locks and dams and dredging.

A comparative estimate of the two enterprises developed the fact that the Panama route could be constructed for approximately $50,000,000 less than the Nicaragua route.

When the fact was considered that the Panama route was shorter and was paralleled by an existing railroad line, the comparative ease of constructing a canal at Panama as against Nicaragua was self-evident.

Therefore the Walker Commission finally recommended the Panama route, on the condition that the French Company would sell their property and rights to the United States for not to exceed $40,000,000, which would put the cost of the two enterprises on a somewhat similar basis.

After the interview above referred to with Generals Ernst and Hains I was impressed with the idea that the administration for various reasons did not desire to have a plan adopted that departed radically from the original plan upon which the estimates were based and upon which Congress had granted the authority for the construction of the canal, as a reference of this matter to Congress might have reopened the entire controversy in regard to the canal and might have instigated the advocates of the Maritime canal route to active opposition, as well as the element in Congress opposed to any canal whatever, and also might have resulted in an investigation as to matters relating to the purchase of the Panama Canal from the French company by the United States Government, and as to the facts connected with the revolution which resulted in the separation of Panama from Colombia.

At least the above theory explained in my own mind the preference of the administration to put through some plan that would not require any additional congressional legislation rather than have the question again opened.

It should be remembered in this connection that when the original Spooner bill was passed the President of the United States had the discretion as to which of the two locations should be selected, and the endorsement by Congress of the selection of the Panama route was based upon the United States Government being able to secure an absolutely clean title to the French rights and property, and the negotiation of a proper treaty with Colombia or the country through which the canal line passed.

About this time I was informed that the President had decided to refer the whole matter of the final plan to a commission of international engineers, on the theory that the European engineers had more knowledge and more experience in canal construction, and on the assumption that inasmuch as the United States Government was constructing the canal for the benefit of the world's commerce, it was but just and proper that the views of the best talent in the world should be secured before a final decision was reached.

This commission did not convene until after my connection with the enterprise had ceased, but during the progress of their investigation and labors I was requested by that commission to present my views to it, which I did in the form of a series of notes which I had previously prepared on various matters connected with the plan, and after which I was subjected to a lengthy cross examination by the various members of the joint commission, all of which can be found embodied in the appendix to the report of that commission, which was published under the authority of Congress and is a matter of public record.

It may be noted here that the majority of this commission, composed of all the foreign engineers and three of the American engineers, recommended the adoption of the sea-level plan, and that a minority composed exclusively of American engineers, reported in favor of the intermediate lake plan, which was also recommended by the then existing canal commission and was finally approved by the President of the United States, and in accordance with this plan the work has since been carried out.

A little later, in February, 1906, I was called before a committee of the United States Senate, when I again had an opportunity to express my views and submit to a cross examination thereon, in connection with other engineers who were familiar with the project, some of whom held views in accord with my own and others contrary thereto.

As long as I thought there was any opportunity of having the sea-level canal plan considered I was its advocate. However, after the administration had concluded to adopt the present plan and the decision was finally made, I considered it my duty as a loyal citizen to avoid further agitation of the subject. I simply note the above in order to place my original views on record with some of my reasons therefor.

During my residence on the isthmus we were much embarrassed by repeated outbreaks of yellow fever. Although the sanitary department introduced a thorough and efficient system of quarantine and used every possible effort to eliminate the fever, they were hampered by a lack of proper support from Washington until the fact was finally borne in upon the authorities there that improved sanitation and the elimination of yellow fever was a paramount necessity before the work could be successfully prosecuted.

When the authorities finally realized the seriousness of this situation and proper support was given to Colonel Gorgas and the officials in charge of the canal, the conditions were speedily remedied.

Personally I was never discouraged by the yellow fever situation, as I had had more or less experience with it in the South during my connection with the Illinois Central Railroad.

During February I had a light attack of fever which my family and the natives of Panama considered to be yellow fever, and thereafter I considered myself immune; but during my administration we lost quite a number of important employees, including Mr. Johnson, the supervising architect, the effect of which was very depressing on the organization as a whole.

As it was the policy of the commission which originally appointed me to preserve pleasant relations with the native element in Panama and Colon, and as it was felt that some social recognition should be given to encourage a friendly attitude on the part of these people, I occupied the residence in the heart of the City of Panama, which had been used by the managing director of the French company. The first night I slept in Panama I occupied this residence and continued to occupy it until my connection with the work ceased.

During the summer of 1904 Admiral Kenny, who was the treasurer of the Isthmian Canal Commission, occupied this residence with me during his stay on the isthmus. I also had with me Mr. William J. Karner, who was my office engineer.

My household staff consisted of a butler who had been with the French administration, a Martinique negress as cook, a Spanish house boy, and a personal valet who was half Spanish and half Irish.

During this summer Mr. Karner was taken down with the fever and taken to the hospital. During his illness he was waited on by my valet, who was later removed to the hospital, and he was followed by the cook, leaving Admiral Kenny, the French butler and myself as the remaining occupants of the house.

Later we secured the services of a Chinese cook who had served under Admiral Walker in Nicaragua. In a few days he was also taken down with the fever and removed.

However, all of these patients finally recovered and returned to their duties.

The residence I occupied, the old Casa Dingler, derived its name from being the residence of M. Dingler, who was considered the most efficient of the French chief engineers, and who occupied the residence with his wife, a son and a daughter. A short time after his arrival his son died of the fever, and later his daughter, and then his wife. This so depressed M. Dingler that he dropped into a state of melancholia.

The family had all been enthusiastic horsemen and each member of the family was provided with mounts brought over from France. After the death of the last of the family, his wife, M. Dingler took his horses up into one of the mountain ravines and shot them, then returned to France and later died in an insane asylum.

To this house I brought my wife in November, 1904, and set up a social center in the heart of the City of Panama. As General Davis, the governor of the zone, was a widower, and John Barrett, the American minister, was a bachelor, our house naturally became the social American center of Panama, and throughout our stay we cultivated and maintained social relations with the leading families on the isthmus.

On November 27, 1904, Secretary and Mrs. Taft made a visit to the isthmus and were our guests for ten days. During this time the first American reception was given at our residence that ever occurred on the isthmus.

At this time Admiral Goodrich and his fleet were in Panama harbor and at this reception were the various naval officers from the fleet, the marine officers from Culebra, and numerous army officers detailed in various positions on the canal work, also the officials of the Panama Republic, the bishop of the Catholic church, the consular representatives of the various foreign governments with their wives, and the leading families of Panama and Colon. The interesting feature was the cosmopolitan characteristics of the people in attendance, representing almost every nationality, at least in that part of the world, and various grades of official rank, politics and religion.

Secretary Taft's visit, with the social activities which grew out of it, and the creation of an American social center, did much to establish harmonious relations between the Panamans and the American element, and I think to some extent made our relations with these people easier to handle.

One of the greatest difficulties we had to contend with was the securing of the necessary labor, both skilled and unskilled. The higher grades were of course obtained by importing Americans from the United States. The backbone and sinew of the force, however, had necessarily to be recruited from among those people and those races that were accustomed to work in a tropical climate.

It was at first considered that Jamaica would be the best source of supply. In an attempt, however, to secure a sufficient force from there we were met by prohibitory regulations upon the part of the Government of Jamaica, which endeavored to impose a tax and conditions so burdensome that they could not be complied with.

On the return of Secretary Taft and William Nelson Cromwell from the isthmus the British Consul, Sir Claude Mallet, a representative from Minister Barrett's office, Mrs. Wallace, and I, accompanied the Secretary on the cruiser *Columbia* to Jamaica, where in response to a cable communication we were met by the Governor of Jamaica and escorted to the King's House, his official residence.

Secretary Taft, after introducing me to the governor and explaining the object of my mission and after some preliminary discussion of the conditions, sailed for the United States, leaving me at Jamaica to endeavor to arrive at some understanding with the governor.

After remaining in Jamaica six days and being cordially entertained by the governor we returned to Colon on the U. S. S. *Dixie*, which touched at Jamaica for coal on her way to Colon, without having accomplished the full purpose of my mission, finding that the only way we could secure labor from Jamaica without submitting to burdensome conditions was to make such gradual acquisitions to our force as might voluntarily come to us from that source of their own initiative.

I then sent various labor agents to other adjoining countries, but owing to the regulations of the Treasury department

was not able to advance them money for their own necessary expenses and the transportation of the laborers which they secured, without which it was impossible to obtain them. In some cases, however, I advanced the money personally.

In this connection I finally sent Mr. Wm. J. Karner to Barbados and made an arrangement with a British steamship company to transport the laborers to Colon, and then upon the rendition of a bill by the steamship company to the Isthmian Canal Commission, certified by the chief engineer, Lieutenant Geo. C. Schafer, the disbursing officer of the Treasury department, arranged to pay for the transportation.

At first this enabled me to secure a moderate supply of labor.

Unexpectedly, due to some ruling of the Treasury department, Lieutenant Schafer declined to pay further bills for transportation. This resulted in the British steamship company notifying their captains touching at Barbados not to transport any more laborers unless their transportation was paid in advance, which, as I had not been able to secure funds for that purpose, cut off this source of supply until Governor Davis came to my rescue and provided funds out of the treasury of the Zone Government, over which he had absolute control, his treasury being afterward reimbursed by the Isthmian Canal Commission upon properly approved bills.

Upon a forcible presentation of the case, however, being made to the commission and by it to the authorities at Washington, Mr. Karner was finally appointed a disbursing officer of the Treasury department and was provided with the necessary funds to take care of the transportation of laborers from Barbados, which from that time on was the principal regular source of supply.

In the meantime negotiations were carried on with a view of obtaining a supply of Chinese labor. This, however, was opposed by the authorities at Washington on account of political considerations, and also by the authorities of Panama, as they did not desire an importation into the Canal Zone of Chinese, who would afterward drift into Panama and Colon and become in the opinion of the Panamans undesirable citizens, due to the fact that the Chinese who had been left on the isthmus at the close of the de Lesseps régime had gone into various lines of trade that were considered competitive.

In June, 1904, when I arrived at Panama, the force in the engineering department consisted of 165 men paid in gold and 1,324 paid in silver, a total force at that time of 1,489 men.

When I left the work, the force employed in the department of construction and engineering consisted of 1,100 men paid in gold and 5,500 natives, negroes and others paid in silver, a total working force of approximately 6,600.

When I first arrived on the isthmus I found it difficult to secure from the authorities in charge of the Panama Railroad, on account of its peculiar organization methods, that degree of coöperation that I considered necessary to properly carry on the canal work, as the railroad was of course one of the principal instrumentalities to successful work.

Ninety-seven per cent of the stock of the Panama Railroad at that time was owned by the United States Government, and while the members of the Isthmian Canal Commission were directors of the railroad, it was directly controlled by a vice-president located in New York and by a general manager under him, also located there. The resident authority on the isthmus in charge of the Panama Railroad was Colonel J. R. Shaler, who at that time was over seventy years of age. He was a perfect type of Southern gentleman, and so far as he was concerned was anxious and more than anxious to do everything possible to assist me in my work. The executive work under him was under the control of Mr. H. G. Prescott, his assistant superintendent, who was also desirous of rendering me all assistance possible.

The first difficulty I had with the railroad was when I desired some frog and switch apparatus placed in the line of the road in order to connect with tracks that led into an engine house in which were stored a number of Belgian engines in good condition, which I desired to transport to Culebra to be used on the canal work.

The putting in of this switch and making a connection with the old tracks required only a few hours work.

I was informed that Colonel Shaler was without authority to make this change without consulting New York, and that under his instructions he did not desire to request the authority by cable and would have to take it up by letter, which would require about three weeks to receive an answer.

With the intimation, however, that if the connection was not made by the railroad force inside of twenty-four hours I would do it with my own force, although this might be considered an unwarranted interference with the operations of the Panama Railroad, I prevailed upon Colonel Shaler to perform the service, and I presume he took the matter up by cable and received the necessary authority.

This incident is only cited as one out of many where it was difficult to secure proper coöperation from this source, on account of organization methods, which while proper for routine operations were not suited to the new situation and conditions.

After a vigorous attempt to get control of the Panama Railroad, I finally in April, 1905, secured a position on the board of directors of the road and was elected vice-president and general manager of the Panama Railroad and steamship line, and thereafter during my continuance on the work had full and complete control of both the railroad and the steamship line as far as their operation was concerned.

During this time I also planned to reconstruct the Panama Railroad as a double track road with improved dock and wharf facilities and reëquip it with proper equipment.

During my connection with the work I suggested the simplification of the tariffs of the Panama Railroad. Mr. Jos. L. Bristow, since elected U. S. Senator from Kansas, was detailed to visit the isthmus and examine into the situation and report. I explained to him my views in full and in detail, and they were embodied in a report which he afterward made and which is part of the government records.

In this report I suggested a modification in the rates of transportation across the isthmus, on a basis that would at least approach the rate per ton which would be charged on the world's commerce after the completion of the canal; the practical doing away with classification, and the collection of all railroad tariff charges from the steamships which either delivered freight to or received freight from the Panama Railroad; and the throwing open of this avenue of transportation to the world's commerce on some equal and uniform basis.

The existing rates over the Panama Railroad at that time were almost prohibitive, and were dependent not only upon the classification of the freight but also upon the origin thereof and the final destination, the theory evidently being to charge all the traffic would bear for transportation between the east and west coast, based on the comparative cost of carrying the freight by the route through the Straits of Magellan.

The most striking example of this was the rate on coffee from Costa Rica, which as I recall it now was at that time $6.00 per ton for the rail transportation of less than fifty miles.

The theory upon which I recommended this innovation in the reduction of rates was based on the provision of improved methods for the handling of freight, the construction of adequate terminal facilities, improved methods of handling from cars, and on the provision of modern equipment, so that the number of tons of freight handled per train might be increased.

At that time the maximum capacity

of freight cars was ten tons, and as the freight was sorted on each side according to destination, a great many loaded cars were handled across the isthmus with only one or two tons of freight to the car. This reduced the amount of tonnage per train so that it increased the cost, which was one of the arguments the railroad traffic officials used against the reduction of rates.

My principal reason, however, for the utilization of this means of transportation before the completion of the canal and during its construction, and reducing the rates, was to encourage the opening up of this line of transportation to the commerce of the world, in order to build up a business prior to the opening of the canal, so as to reduce the length of time after the canal was completed in which this tonnage would be increased to such an amount as would place the canal on a paying basis.

I recommended $2.00 a ton, without regard to classification, as a proper rate.

One of the objections raised to my suggestion was that this would create a disturbance in through transcontinental rates. My natural answer to this was the inquiry as to the purpose for which we were constructing the canal. The reply was that during the ten years that would be required for the completion of the canal, the transcontinental lines would have time to meet the new conditions.

In answer to this I developed the fact that while the actual rate paid for freight across the isthmus was concealed in the proportions of the through rate between west and east coast points and between origin and destination, and was not expressed in so many dollars per ton, as far as traffic between New York and San Francisco was concerned the Panama Railroad's proportion of the rate gave a revenue that averaged less than $2.00 per ton considering all classes of freight. This against the fact that coffee from Costa Rica had to bear a charge of $6.00 a ton.

It was my understanding with Admiral Walker and the Isthmian Canal Commission that civil service rules would not be put into effect in regard to the Panama work until after the preliminary organization was made effective, and then only under such regulations as would be practically adapted to this work.

On November 17, 1904, I received a cablegram advising me that the Isthmian Canal Commission had been placed under civil service rules, which was confirmed by the following letter:

Washington, D. C.
November 17, 1904.

Mr. John F. Wallace, Chief Engineer,
Isthmian Canal Commission, Acon, Canal Zone.

Dear Sir:

I beg to advise you that under date of November 15, 1904, the President signed the decree placing the Isthmian Canal Commission under civil service rules, and I enclose herewith a copy of the classification of this commission, with a list of the exceptions made thereto, for your guidance.

Very respectfully,
J. G. WALKER,
Chairman of Commission.

I remonstrated with the chairman of the commission on this order and requested him to take the matter up with the President, which he declined to do.

At that time Senator Kittredge was on the isthmus and I explained this situation to him thoroughly and suggested that I be permitted to have a conference with the civil service commissioners, in order to formulate such regulations as would enable the system to work out in a practical way.

Senator Kittredge succeeded in securing a suspension of the immediate application of the order, and when Commissioner Greene and Chief Examiner Snyder, of the civil service commission, visited the isthmus I went over the situation with them on the ground and a modification of the original order was finally arranged between us, which, although it did not fully meet my views, was a step in the right direction; but many difficulties afterward arose in its application.

It is needless to say that this work was of such a peculiar nature, in a foreign country, and conducted under such strenuous

conditions, that to whatever extent the civil service rules were made to apply to it they were to that extent an impediment to the efficient and economical conduct of the work.

One incident that occurred in the later application of these rules was in connection with a requisition I made for a certain number of track foremen. After several weeks of waiting one foreman was finally furnished me, who, upon being placed in charge of a gang of track laborers to put in a switch, confessed that he knew nothing about track work and that his only experience as foreman had been in a bicycle repair shop.

The utter impracticability of selecting expert technical or mechanical help qualified to render efficient and effective service in a tropical climate thousands of miles away from headquarters, should be apparent to every practical man.

While I have always been in accord with a short working day, the strict enforcement of the eight-hour day under the legal requirements in force in the United States interfered seriously and must have since added materially to the estimated cost of the work.

To those familiar with constructive operations it will be realized that a large amount of work was needed prior to the commencement of work hours and also subsequent thereto, in preparing for the day's work and in straightening matters up thereafter. This particularly applied to work in the transportation department.

Without a great loss of efficiency, trains could not be permitted to stand at the exact point that they occupied on the stroke of the hour, and the cleaning up of transportation work after the day's work and preparation for it before it commenced necessitated more or less overtime work upon the part of employees in this department. Other parts of the work were similarly affected thereby, although the essence of the eight-hour day for the mechanic or the laborer employed at individual effort could be observed.

The various difficulties and drawbacks enumerated above have not been mentioned with any view of criticism of individuals, but simply to call attention to the difficulties of supervision from Washington, by officials of the Government departments, of constructive work, particularly in a foreign tropical country, and on work of this character where such unusual conditions existed and unforeseen complications arose daily, which in order to secure efficient and economical results had to be handled and decided upon by some authoritative agency on the spot.

Even in the history of our own Civil War the immediate success of the earlier and able generals in charge of campaigns was partially nullified, not through their own acts or their inability to understand or cope with the situation, but through the lack of a proper appreciation of the conditions and necessities surrounding the field of operations and the pressure, through the press and otherwise, of an impatient public, as well as the failure of the administration and public to appreciate at the start the necessity of concentrated authority and the lack of patience to calmly wait for the accomplishment of the necessary preparation in order that the foundations for more effective work in the future might be accomplished.

The foundations of all great structures are hidden from sight, and only the architectural effect of an imposing building resting thereon appreciated.

Nevertheless without the foundations the final structure could not be erected, and without any expectation of public appreciation either at present or in the future, I felt in my own conscience that my compensation would consist in the personal feeling that during the strenuous period of preparation at least a foundation of ideas in organization and plans had been made, and that the misunderstandings which I may have had with the administration and those above me at least made the way easier for my successors.

I do not feel it necessary to attempt to

analyze or to express to the public the complexity of causes which led up to my resignation, further than to say that my controlling motive was not due to any desire to better myself in a financial way or to obtain through the offering of my resignation any personal consideration.

While it might have been temporarily postponed if more frankness had been exercised in the consideration of the matter, both by the administration and myself, owing to certain irritating circumstances to which undue importance was probably attached by all concerned, still the conditions surrounding the work and the policy of the administration seemed to me then, and still seem even with the reflection that has come with the years that have since passed, to make it necessary for me to sever my connection with the work, as it seemed utterly impossible for the administration, uninfluenced by outside interference, to take at that time the proper view which was essential for the efficient conduct of the work, an attitude to which the administration finally came and due to which the eventual successful completion of the work has been obtained.

CHAPTER XXXVI

THE RAILROAD MEN AT PANAMA*

MR. SHONTS BECOMES CHAIRMAN OF THE COMMISSION—HE SECURES JOHN F. STEVENS AS CHIEF ENGINEER—RAILROAD MEN AS HEADS OF DEPARTMENTS—DEADLY CLIMATIC CONDITIONS—MAKING THE ZONE HABITABLE—FRENCH AND AMERICAN DEATH-RATES COMPARED—SOLUTION OF THE LABOR PROBLEM—HOUSING AND FEEDING THE TROPICAL ARMY—WHY A LOCK CANAL WAS CONSTRUCTED—ORGANIZATION OF THE FORCES.

BY THEODORE P. SHONTS

IT was toward the latter part of March, 1905, while on a cruise among the West Indies on board the United States dispatch-boat *Dolphin*, with Senator Hale, of Maine, and Representatives Cannon of Illinois and Meyer of Louisiana, as guests of the late Paul Morton, Secretary of the Navy, that I received a cablegram from President Roosevelt asking me to accept the chairmanship of the commission then in process of formation to construct the canal across the Isthmus of Panama. The president's message was delivered on board the *Dolphin* at Guantanamo, our naval station on the southeastern coast of Cuba, and I had time to consider the proposition during the several days that elapsed before we went ashore at Fernandina, Florida, to take train for Washington. Knowing as little about the big project at Panama as anyone who kept track of current events at all, I was nevertheless aware that the first commission, of which Rear-Admiral Walker was chairman, had not—to quote Secretary of War Taft—"so developed itself into an executive body as to give hope that it might be used successfully as an instrument for carrying on the immense executive burden involved in the construction of the canal." I recognized the shrewdness and wisdom of the President in choosing a railroad man to shoulder the "executive burden," for, after all, the big problem of the canal was one of transportation—the moving of the excavated material from the cut to the spill banks, and the moving of sand, rock, cement, and iron to the points for the location of the locks along the route. The engineering problem was one of magnitude rather than complexity. If the project had been to do a similar job in a developed country and a temperate climate, it would have been attended with no especial difficulties; the fact that conditions approximating modern development had to be brought into existence in a tropical wilderness two thousand miles from the base of supplies for the work itself and the men performing it, was what made it interesting.

While the acceptance of the President's offer meant material sacrifice, I considered it a patriotic duty to accept, providing only that certain views I held, whereby I believed I might achieve success, were met. And I own that I felt some pride in being chosen for an important part in a historic enterprise fraught with such enormous potentialities to the entire world and for all time. The views referred to I set forth to Mr. Roosevelt in his office at the White House, the day after my arrival in Washington from Fernandina.

"Mr. President," I said to him, "I have an idea that when you learn the conditions under which I am willing to become chairman of the Isthmian Commission you may withdraw your offer. With a body composed of so many different members with diversified duties that are likely to conflict on occasion, there is bound to be

*Courtesy of the North American Review.

friction so long as responsibility is divided. I should not care to accept the chairmanship of this commission, therefore, unless it is understood that I am to have absolute authority as to both men and measures in the work of the construction of the canal—subject to your approval, of course."

Mr. Roosevelt's response was characteristic. He rose and threw open the door of his office to the newspaper correspondents, whom he had summoned for the purpose of acquainting them with my decision—provided it should be acceptance of the post he had offered.

"Gentlemen," he said, "allow me to introduce to you the chairman of the Isthmian Commission, who is to have absolute control of the construction of the Panama Canal."

It was a propitious outcome of my acquaintance among railroad officials that I was able to put my hands upon men especially fitted to become heads of the various departments of the canal work. Following the resignation of John F. Wallace as chief engineer, I had the good fortune in June to secure in his place John F. Stevens. Mr. Stevens had been active in the construction of the Great Northern Railway, and afterward in its operation. He severed his connection with the Rock Island Railroad as vice-president in charge of operation to accept the position of chief engineer of the canal. On his resigning this position, after having succeeded me as chairman of the Isthmian Commission in March, 1907, he became vice-president in charge of operation maintenance of the New Haven lines, and subsequently president of a railroad constructed by him across the state of Oregon for the Hill system. Mr. Stevens's first assistant at Panama was J. G. Sullivan, who is now chief engineer of the Canadian Pacific Railroad. David W. Ross, who had been purchasing agent and afterward superintendent of transportation of the Illinois Central Railroad, left the latter position to become the head of the canal's purchasing department, and is at present vice-president of the Interborough Rapid Transit Company, of New York. Edward J. Williams, paymaster of the Chicago & Northwestern Railroad, became disbursing officer on the isthmus, and up to date has paid out $250,000,000 without an error. From the Chicago & Rock Island road, where he was assistant general manager, came W. G. Bierd to take charge as general superintendent of the operation of the Panama Railroad. The Oregon Railway & Navigation Company, a part of the Harriman system, contributed its general auditor, E. S. Benson, who assumed control of the accounting department of the canal construction. W. G. Tubby, for years general storekeeper of the Great Northern Railroad, left that position to perform the same duties at Panama. Jackson Smith, who, as a railroad contractor and in other capacities, had had a very extensive experience with construction labor, took charge of the department of labor and quarters. Richard Reid Rogers, who was general counsel to the Isthmian Commission and the Panama Railroad, still holds the latter position, and is also general counsel to the Interborough Rapid Transit Company. W. Leon Pepperman, who had formerly been assistant chief of the bureau of insular affairs at Washington, was chief of the office of administration of the commission, and to-day holds the position of assistant to the president of the Interborough Rapid Transit Company.

Colonel W. C. Gorgas was at Panama when I became chairman of the Isthmian Commission, and his splendid services as sanitation officer had given him an international reputation. Charles E. Magoon was the civil governor of the Canal Zone and a member of the commission. The other members were Mr. Stevens, Rear-Admiral Mordecai T. Endicott of the navy, General Peter C. Hains, a retired officer of the army, Colonel Oswald H. Ernst, of the engineer corps of the army, and Benjamin M. Harrod, all capable and efficient men.





1. Steam drills at work preparing for blasting.
2. Steam shovel loading a Lidgerwood train, 1906.





1. Battery of well drills at work in foreground and another in the background, preparing for a gigantic blast.
2. Battery of tripod drills at work.

ages had accumulated around the dwellings and in the streets, undisturbed except when washed away by torrential storms. Pools of stagnant water had existed for years in proximity to dwellings, and insect-breeding swamps lay undrained adjacent to the cities and many of the towns.

Under the direction of Colonel Gorgas 3,500 men were put at work on sanitation. Panama, Colon and the towns, villages, and labor camps in the Canal Zone were fumigated over and over again, at first house by house to stop the spread of the disease, and afterward as units, one city, village, or camp at a time. Yellow fever was extirpated in less than four months, and there has been no return of the disease. In June, 1905, there were 62 cases of yellow fever on the isthmus; in July, 42; in August, 27; in September, 6; and in October, the worst month of the year for the disease, 3, not one of these last among the employees, and all originating many miles from the line of the canal. To understand what was accomplished by our sanitary work it is only necessary to compare the death-rate on the isthmus during the French occupancy with that after Colonel Gorgas began to "clean up." In August, 1882, the second year of the French occupancy, with a force of 1,900 men, the death-rate was 112 per thousand. In August, 1905, with a force of 12,000 men, there were only 8 deaths, or two-thirds of a man per thousand. The average daily sick-rate among the employees of the commission during the ten months from January 1, 1906, to October 31, 1906, was 28 per thousand, which was no higher than might have been expected in an equal number of laborers engaged in construction work in any part of the world. So far as general health conditions were concerned, no stronger evidence for their favorable character may be adduced than the fact that among about 6,000 white Americans, including women and children, on the isthmus during the rainy season of 1906—August, September and October—there was not a single death from disease.

Within our first four months on the isthmus we established a hospital system that included a large hospital at Colon, another at Ancon, and a number of smaller hospitals along the line of the canal. The one at Colon was built on piers over the Atlantic Ocean, and patients there had at all times the benefit of cool and invigorating sea air. The hospital at Ancon was, and is, one of the largest and best equipped in the world, situated on the hill above Panama and commanding a superb view of mountains and sea. Colonel Gorgas organized a staff of physicians and nurses inferior to none in civilization. President Roosevelt, in a special message to Congress written after his personal inspection of the isthmus, said of the sanitary work there that "the results have been astounding," and that "the conditions as regards sickness and the death-rate compare favorably with reasonably healthy localities in the United States."

During the railroad men's régime on the isthmus we converted the City of Panama, which on our arrival was without pavement, sewers, or water supply, into the best-paved, the best-watered, and the best-sewered city in Central America or the northern half of South America. We constructed for it a great reservoir with an abundant supply of pure water, and installed for it a fire service that on two occasions has saved the city from destruction. We also constructed for Colon a great reservoir, with a capacity of 508,000,000 gallons. We paved the main street of Colon with vitrified brick, and raised the surface of other streets and covered them with crushed rock. Before we left the Canal Zone it was as safe a place to visit as most other parts of the world, and much safer than many parts of the United States, so far as danger from disease was concerned. Observance of sanitary laws and regulations was compulsory and rigidly enforced. Whenever an employee of the commission was discovered with too high a temperature, he was compelled to go to the hospital, whether he wanted to or not. To

Colonel Gorgas is due all the praise for the triumph of science over disease on the Isthmus of Panama, but he would not have accomplished the magnificent results achieved there without the active and sympathetic coöperation of the commission. The United States paid out something like $4,000,000 in less than a year in the sanitation of the canal route, and Colonel Gorgas has said that he would not have dared authorize the expenditure of that great sum on his own initiative.

The problem of labor for the construction of the canal was almost the paramount one. The clerical forces and skilled artisans were recruited in the United States, though at first some difficulty was experienced in securing the right class of men, owing to the reputation of the Canal Zone as a disease center. To supply the unskilled labor was a far more perplexing task. During the twelve years the French had been operating on the isthmus, they had depended upon the West Indian negro for this class of work. We soon found that if the canal was to be completed within any reasonable limit of time or expense, some other source of obtaining labor must be developed, not only to obtain a better grade and a surer supply, but to eliminate the sense of security the West Indians possessed in the assurance that they controlled the situation by virtue of a labor monopoly. Agents were sent to Europe, and they succeeded in directing to the isthmus a stream of Spanish, Italian, and Greek laborers, though the negroes have all along far outnumbered the others. The erection of living-quarters for the employees and supplying them with good food and pure water was accomplished during the same period that the sanitation of the Canal Zone was carried on. Employees of every grade, white and black, were given, free of rent, with free lights and fuel, comfortable furnished houses. While many hundreds of these houses, of various classes and capacities, were taken over from the French, all of them had to be rebuilt and made sanitary, and in addition new dwelling-houses and living-quarters, hotels, restaurants, clubhouses, schoolhouses, courthouses, postoffices, jails, commissary buildings, fire-engine houses, shops and railway buildings had to be provided. Along the line of the canal we built a succession of trim villages, containing populations ranging from a few hundred up to 5,000 each. At Gatun, the site of the great dam that now holds back the waters of an inland lake 165 square miles in extent, a village sprang into existence within four months, supplied with pure water and a modern sewerage system. At Culebra, situated upon bluffs overlooking the great cut and surrounded with an amphitheater by the rising slopes of beautiful hills, a town of 5,000 inhabitants came into being with its modern sewers and water supply, on a site that a year and a half before was covered by an impenetrable jungle. Among other towns and villages we constructed along the route of the canal are Empire, Las Cascadas, and Gorgona, and in every one of these centers of population there is, in addition to the quarters and mess-halls for the employees, a clubhouse, or recreation building, each with its gymnasium, its reception, card, and billiard rooms and its assembly-hall, managed in conjunction with the Young Men's Christian Association by boards of directors selected from among the men themselves.

The food-supply proved a serious corollary of the labor proposition. If we could not feed the men, we could not build the canal. Owing to the fact that the Panama natives never look beyond their present necessities, no food ever accumulates on the isthmus, and in the summer of 1905 this disastrous condition was augmented by an almost total failure of the crops for the two preceding years, by the abandonment by agricultural laborers of the farms back in the hills for work on the canal at better pay for shorter hours, and by quarantine of the port of Panama because of bubonic plague, which prevented the delivery of foodstuffs from neighboring provinces. We

were thus brought face to face with the problem of feeding 12,000 men and their families, and our nearest available market was 2,000 miles away. We immediately arranged to open local commissary stores at every important labor camp, to provide mess-houses, and to furnish food, both cooked and uncooked, to all employees at cost. Orders were cabled to have our steamers equipped with refrigerating plants; a cold storage plant was erected at Colon, and refrigerator cars were purchased for immediate shipment to the isthmus, thus establishing a line of refrigeration from the markets of the United States to the commissary stations along the line of the canal. The net result of these efforts was that all employees were afforded opportunity to obtain an abundant supply of wholesome food at reasonable prices. We learned from experience that no price for food was sufficiently small to induce the West Indian laborers to eat enough to keep them in good physical condition. They were offered cooked food at ten cents per meal, and the uncooked material at a price reduced by the cost of cooking and service. Both plans resulted unsatisfactorily. We even tried giving them uncooked food free; they declined to go to the trouble of cooking it. Next we had it cooked and offered it to them free, when for the first time they ate heartily. The plan was then adopted that is followed in railway and other construction work in this country, and we paid the West Indians a fixed wage that included three meals per day.

Simultaneously with the sanitation of the isthmus and the erection of comfortable living-quarters for the employees and the establishment of a refrigerating system to supply them with wholesome food, we reconstructed the Panama Railroad, the most valuable instrument to the construction of the canal acquired by the United States in its purchase from the French at Panama. However, the modernizing of the road was a tremendous task. It had but a single track, practically no sidings or station buildings, a worn-out telegraph line, no terminals worthy of the name, and motive power and rolling stock that were obsolete twenty years before. Canal and commercial traffic, local and through, were nearly at a standstill; thousands of tons of through freight were piled in cars and warehouses or on the docks, and some of these shipments had lain undisturbed from three months to a year and a half, in many instances even the shipping papers and freight records having been lost. Had the docks, wharves, warehouses, terminal yards, locomotives, and cars of the Panama Railroad been in good repair, they would still have been entirely inadequate to handle and care properly for the small commercial business the road was transacting. The existing facilities, poor as they were, were rendered less effective by the entire absence of any mechanical appliances on the docks for receiving or discharging cargo from the steamships. The negro laborer was the only power employed; he was at once the hoisting-machine and traveling-crane. Imagine conditions, then, when the accumulated orders in the States for canal material began to arrive in large quantities on both sides of the isthmus. The situation was aggravated while the congestion was at its densest by an increase of fifty per cent. over the year before in the commercial business of the road, and at the moment when we believed that our predicament could not possibly be worse an outbreak of bubonic plague at La Boca resulted in two consecutive quarantines, completely closing that outlet for sixty days. Furthermore, the personnel of the Panama Railroad as it was turned over to us had not been educated on modern lines, and was completely paralyzed when confronted with the onerous conditions caused by the congestion of freight. It was necessary, therefore, to begin at once the construction of new wharves equipped with modern mechanical appliances and of large terminal yards at both ends of the road; of extensive warehouses, of suitable machine shops, and of modern

coal-hoisting plants. New and more powerful locomotives and larger cars were purchased for both passenger and freight service. The personnel of the road was reorganized, and into the more important positions we put experienced, energetic, up-to-date railroad men from the United States, where, indeed, we recruited our entire complement of yard and train masters, superintendents of transportation, train-dispatchers, and master mechanics, and an army of conductors, engineers, and switchmen. We double-tracked the road with heavier steel rails, strengthened the bridges to enable them to withstand the weight of our heavier equipment, and in 1907 the line across the Isthmus of Panama was in a position to bear favorable comparison with the average of the best railroads in North America.

Of course the most important question before the commission was as to whether the canal should be of the so-called sea-level or the lock type. The Act of Congress which authorized the President to proceed with the construction of the canal gave him almost unlimited discretion as to details of route, type, and size, the principal limiting clause being that it "shall be of sufficient capacity and depth as shall afford convenient passage for the vessels of the largest tonnage and greatest draft now in use and such as may be reasonably anticipated." The discussion on this question, which was largely one of engineering technicalities, occupied many months, and the decision we arrived at is summarized in the following extract from an address I delivered before the chamber of commerce of Atlanta, Georgia, in May, 1906:—

"The present commission believes that the type of canal the people of this country want is the one which will provide adequate and safe passage for the largest vessels now on the seas, or which can be reasonably anticipated, and which can be constructed in the quickest time and at the least cost. It has, therefore, recommended the construction of an eighty-five-foot-level lock canal, for the reasons that, first, in its judgment, 'it can be completed for about half the cost, and in about half the time, of the so-called sea-level canal; second, because it will be adequate for all the commerce which can reasonably be expected to seek that route during the next 150 years; third, because if the tonnage should increase beyond such expectation it can be enlarged more cheaply and more quickly than the so-called sea-level canal; fourth, because, from the operating point of view, large ships can be put through more safely and more quickly than the so-called sea-level; fifth, because, when the construction is added to the estimated cost of operation, the saving to the Government every year will be $2,340,000; sixth, because, when built, it will be a completed canal, completed in every appointment, for all requirements for generations to come.'"

It had been agreed between Mr. Roosevelt and myself when I accepted the chairmanship of the Isthmian Commission that I might withdraw from that position, with his sanction, so soon as the construction of the canal was under full headway. I did not, therefore, sever all my railroad connections, although for two years I devoted my entire physical and mental energies to the problems of the big ditch. My resignation was not handed in until 35,000 men—within 5,000 or 6,000 of the maximum number employed—were on the commission's pay-rolls; all the machinery essential to the completion of the canal, except that for the lock construction, had been designed, constructed, assembled on the isthmus and put into operation; the more serious difficulties attendant upon industrial operations in the torrid zone overcome, and the entire project well under way.

Colonel Goethals's splendid achievement in carrying to practical completion, without setback or delay, without a hitch of any kind or a hint of scandal, the great work of the construction of the Panama Canal, while demonstrating the thoroughness with which the railroad men pre-

pared the way on the isthmus and the care and precision with which their plans were laid, is one of which the United States Army may well be proud. Incidentally it may be remarked that so wisely considered was the order of President Roosevelt, issued to the commission of which I was chairman in November, 1905, that it has not since been necessary to amend it in any important particular. The order was as follows:

"The organization shall consist of the chairman and the following heads of departments: Chief engineer, general counsel, chief sanitary officer, general purchasing officer, general auditor, and manager of labor and quarters. The duties of each shall be as follows:

"1. The chairman shall have charge of all departments incident and necessary to the construction of the canal or any of its accessories.

"2. He shall appoint the heads of the various departments, subject to the approval of the commission.

"3. The head of each department shall report to and receive instructions from the chairman."

This order, with a subsequent minor amendment, is that of the present organization on the isthmus, except that there have been changes made in the titles of the heads of departments to conform with military usage. It was this concentration of supreme authority in one man that has enabled Colonel Goethals, as head of the military régime at Panama, to carry on and complete in such manner as to command the wonder and admiration of the world the work planned and begun under the railroad régime, as to enable me—encouraged by the loyal and able coöperation of the other members of the commission and heads of departments—to accomplish such vast results in so short a time.

CHAPTER XXXVII

THE TRUTH OF HISTORY

MR. STEVENS BECOMES CHIEF ENGINEER—FINDS A BAD STATE OF AFFAIRS—SANITATION OF PANAMA AND COLON ACCOMPLISHED—HERCULEAN TASK OF CREATING AN ORGANIZATION—COMMISSION GIVES ITS COÖPERATION—LABOR PROBLEM SETTLED—THE FEEDING CONTRACT—RECONSTRUCTION OF PANAMA RAILROAD—HEADS OF DIVISIONS—BUILDING NEW TOWNS—CHIEF ENGINEER RECOMMENDS LOCK-TYPE CANAL—REAL CONSTRUCTION BEGUN—THE CONTRACT PLAN CONSIDERED AND ABANDONED—MR. STEVENS OUTLINES TO PRESIDENT ROOSEVELT HIS PLAN OF COMMISSION ORGANIZATION—THE PRESIDENT SUPPORTS HIM—NO RED TAPE—ATTITUDE OF THE PRESS—ARMY ENGINEERS INHERIT A WELL-PLANNED AND WELL-BUILT MACHINE.

BY JNO. F. STEVENS

MY connection with the Panama Canal began on July, 1, 1905, my appointment as chief engineer of the Isthmian Canal Commission taking effect upon that date, to succeed Mr. John F. Wallace, who had resigned three days previously. When the position was first offered to me I did not look upon it with favor, and had made up my mind to refuse it, but after a conference solicited by him I succumbed to the persuasive tongue of William Nelson Cromwell, who, among the many others, seemed to have a deep and heartfelt interest in the success of the proposed work. And as the matter was presented to me, in view of the discouraging condition into which affairs had drifted during the period of American occupation, as a loyal American citizen, and as a cordial supporter of an administration which was represented as being much exercised over the situation, it became my duty to waive personal inclinations, and to accept the responsibilities of the position. I accordingly did so, and the arrangement verbally agreed upon between Mr. Cromwell and myself was confirmed by the chairman of the commission, on the date noted.

As soon as practicable thereafter, I sailed for the Canal Zone, landing there on July 26, taking immediate and personal charge of all affairs there (excepting government and sanitation), including the Panama Railroad, and I believe I faced about as discouraging a proposition as was ever presented to a construction engineer.

In any comments I may make upon the condition of affairs which existed there at that time, no reflection whatever is intended upon the ability of my predecessor. I had known Mr. Wallace for many years, as a high-class engineer and railway operator of great experience, and I was not long in deciding in my own mind, why and how the situation had developed as it existed. The ineffective organization of the Walker commission, the utter lack of responsibility definitely located, the endeavor to decide and act upon the most trivial matters, at a distance of two thousand miles by a body of seven men, each of equal rank, who were apparently unable to agree with each other, or with anybody else, would have been sufficient reason for a partial, or even a total failure, no matter who might have been the chief engineer.

The retirement of this commission, and the organization of the new one, on April 1, 1905, might have bettered matters, but it had not to any great extent, during the three months the latter had been in power.

There were probably several reasons for this; it would have taken a longer time than three months to have recovered from the deplorable state of affairs left by the old commission in any case, but I have always believed (and I had a fairly good opportunity to judge), that a lack of harmony or sympathy between the chief engineer and the chairman of the new commission was the greatest single contributing cause leading to a comparative failure to produce results. But there was no time to "look mournfully back into the past." The problem of changing the situation had to be grappled with, without delay, and in such manner as human judgment could best devise to meet the emergency, which was truly formidable.

Under the agreement between the United States and the Republic of Panama the former was charged with the regulation of sanitary matters in the cities of Colon and Panama. To carry out this obligation successfully required the paving, sewerage and the providing of an ample supply of water for both cities. At the time of my taking charge, plans had been adopted for the water plants of both cities and considerable work had been done on them. Much material for the paving of Panama had been ordered, and so far as the arrangements for the sanitation of these two cities had been carried, the work was creditably done. There remained, however, much yet to do, not only in Colon and Panama, but in all of the then existing towns, and others soon to spring up along the Canal Zone.

From time to time, during the past seven years, very flattering notices have appeared in various newspapers of the United States, of the condition of Colon and Panama, as regards streets, sewers and water supply. They were all true, but in justice to the engineers in civil life, who designed and built these works and wrought these changes, it should be remembered that all this was accomplished before the advent of the army engineers, and was not done by the latter, as mistakenly asserted by the articles in question.

When I reached the zone, conditions could have been worse, but they were bad enough. No real start at any effective work on the canal proper had been made, no organization worthy the name had been effected, sanitary reforms were really just beginning, little new plant had been provided, and little that was absolutely needed had been ordered. And plant and material that had been under requisition for months was so delayed in delivery as to paralyze the efforts of those who, to the best of their ability and means, were trying hard to get results.

In such organization as existed, no coöperation was apparent—exactly the opposite—and no systematic plans, as far as could be discovered, had been formulated toward carrying out the work along lines promising any degree of success.

And, worse than all, over and above in the diseased imaginations of the disjointed force of white employees, hovered the Angel of Death in the shape of yellow fever, a number of cases of which were then prevailing and from which several deaths had occurred. What many of the otherwise intelligent men seemed to expect was an order to abandon the work and go home.

To provide housing for this army, with its future great increase; to properly feed, to instill in them faith in the ultimate success of the great project, to weed out the hopeless doubters and incompetents, to create an organization fitted to undertake the tremendous work, and to fill its ranks with the proper material, was a task of heroic proportions. No one will ever know, no one can realize, the call on mind and body which was made upon a few for weary months, while all the necessary preliminary work was being planned and carried forward; and no attempt was or could be made to carry on actual construction until such preliminaries were well in hand.

While the French turned over to us square miles of engines, cars, rails, dredges, tools and plant of all descriptions, very

little of it was of practical value, and such of it as was used, was generally only until proper modern appliances could be substituted; but as time wore on, as new plant arrived and was put into service, as the force increased, as proper food and housing were provided, as improved health conditions prevailed, as the majority saw that—unconsciously perhaps to them—a real effective organization, working steadily but surely towards a definite, intelligent end had been made, the whole situation changed for the better; and that the organization was effective, the plant well designed, the working plans rightly conceived, is evident from the fact that the construction of the canal since the real beginning of work early in 1906, with but small addition to plant in hand, or under order, or material change in organization, went steadily and smoothly on to completion, with a rapidity and economy that long ago confounded and silenced carping criticism.

The work of the Sanitary Department was under the direction of Colonel (now General) Gorgas. And, as the success or failure of the entire work of building the canal rested upon the underlying basis of good health conditions, it may truthfully be said that the responsibilities of that department were of the first and prime importance. Disease and death would have conquered de Lesseps even if his finances had held out. And they would have conquered us, if, in the light of latter-day science, General Gorgas and his staff of able, devoted assistants had not so successfully handled the situation.

There seemed to exist, unfortunately, a general feeling, outside of the medical staff, that the work being inaugurated and carried on by this department was largely experimental, and doubts were expressed on all sides as to its permanent success.

General Gorgas was under the jurisdiction of the governor of the zone, who was a member of the commission. But I failed to find the hearty coöperation to exist which was so necessary to success. Large amounts had to be expended by the department, prompt decisions involving big questions had to be made, and I judged that the governor, being, as indeed we all were, totally unacquainted with such a problem, had a natural reluctance in assuming the great responsibilities involved. In fact, the chairman expressed the opinion that much money was being wasted by the department and seemed inclined rather to criticise than to suggest.

In line with the policy I adopted, as explained later, and knowing full well that all my efforts would end in failure, lacking proper sanitary conditions, I took the bull by the horns, regardless of regulations or red tape, and threw all the weight of the Engineering Department to the aid of General Gorgas, coöperating with him in every possible manner.

Labor was scarce at that time, but the Sanitary Department had the first call and its requisitions for laborers had preference over all others. Without waiting for orders, or even approval, the Engineering Department built roads, sewers, waterworks, hospitals, and many other essentials, at the request of General Gorgas, and I am certain that he knows and appreciates too, that the real success which crowned so royally the labors of his department began to date from the autumn of 1905; and while I know that the Engineering Department—during the period I was connected with it—has justly to its credit many things of importance, there is no single one of them all that I take more pride in as time goes by than that of the aid and help we gave to the Sanitary Department, when it was so sadly needed.

With the light of what I could plainly see had been the experience of Mr. Wallace, I determined from the start, or as soon as I could grasp the significance of affairs, that the only line of policy that promised success was one of going ahead and doing things on my own initiative, without waiting for orders or approval. One of the terms I insisted upon before I became chief engineer was that I should be un-







1. Y. M. C. A. Clubhouse Reading Room at Panama.
2. Group of Spanish Laborers.
3. West Indian Kitchen.

hampered in my work in any way, shape or manner, and I am free to say this agreement was strictly kept. The distance of the commission from the work as well as its make-up, did not admit of any other plan of procedure. As constituted, the members of the commission, who were civil engineers, were designated to act in an advisory capacity. But I knew full well that none of the board had the experience in either such construction work or transportation matters that would qualify them to dictate to me how matters should be planned and handled, and frankly I determined early that they should not.

I wish candidly to say that the commission cheerfully, as far as I know, accepted the situation, coöperated with me to the utmost, and approved formally of all my acts. I was accused by busy-bodies of being a law unto myself, of having cut the cable and all such nonsense. Not a word of truth in such talk. The commission was always kept advised by me, in due course of time, as to current events and what I had done. As a rule I never requested approval in advance for detailed expenditures in any line whatever; on the Isthmus I went ahead, made plans, saw they were executed, and later on advised the commission in fair detail what I had done, what I had expended, and asked approval, which was always quickly given.

In assuming such responsibility I felt I was taking the only sure course, although I fully realized that on me, primarily, would fall the blame, should my plans not develop into success. But I had been used all my life to accept responsibility, and a man who will not had better stay on the old farm. The only true basis of successful organization is the lodging of authority and of responsibility for results. And in this case, after I had in a way understood the plans and aims of the Sanitary Department, not a shadow of doubt remained in my mind as to ultimate success of the great project—provided the right type for the canal was adopted.

Of the many important matters that pertained wholly to the Engineering Department was the securing of the necessary labor, both skilled and unskilled, to carry out our plans, which were slowly but surely being evolved. All common labor, for years,—for the Panama Railroad, and in fact for most of the ports in different countries along the Gulf of Mexico and Caribbean Sea,—had been black, drawn from the islands of the latter. Such supply had so far proven insufficient in either amount or quality, and I at once saw that it had to be made better, if possible, by raising its standard, either within itself, or by introducing a sufficient number of a higher grade to leaven the mass.

My first thought was, naturally, Chinamen, as I had observed their good qualities for years in railway and other similar works on the Pacific Coast. But, after due consideration, through the commission, this idea was dismissed for good reasons. Then, attention having been called to the possibilities which Spain offered as a source of supply, I sent an agent to Madrid —a man well versed in Spanish law and a fluent linguist—with orders to secure several thousand men from the Biscayan provinces. This, after some difficulties, he was able to do through the assistance of the steamship companies. Their introduction as expected resulted in such a marked improvement in labor conditions that altogether nearly eight thousand of them were brought over.

At the same time, measures were taken to provide a systematic method for securing an ample supply of blacks by establishing agencies in the various English and French islands, and in a comparatively short time the problem of the necessary amount of common labor was solved.

All skilled labor was drawn from the United States, agents for such purpose having been placed in several of our large cities—those that were centers of manufacturing and railway activity. In spite of handicaps which ought never to have existed, we succeeded wonderfully well,

and after due course of time were able to keep the ranks full of all good classes—all this work being handled directly by and through our organization on the Isthmus. One of our handicaps in securing these skilled laborers was the insidious and disloyal attitude displayed by some of our home newspapers and magazines in depicting to their readers the terrible health and living conditions alleged to prevail on the Isthmus, long after the zone had become a safer and healthier place of residence than the very cities in which some of these papers were published. The words of irresponsible letter-writers were taken in direct contradiction of the facts, and screeds were eagerly scattered broadcast, poisoning the public mind, all probably for the sake of sensationalism. By me, such publications could only be given the name they would be called, if the nation was engaged in a foreign war.

The system under which food supplies were handled to the vast army of employees was an amplification of the plan under which the Panama Railroad had been supplying necessities to its men. But the enormous expansion in the demand, and the endless multiplicity of detail involved, together with the securing, housing and care of the force, made necessary the establishment of the division of labor and quarters, subordinate to the Engineering Department. This division was placed in charge of the late Jackson Smith, under whose able direction the details were all carefully worked out, and the entire problem solved in such a systematic manner that these very important matters became but coördinate parts of a well-oiled and smoothly running machine.

As, naturally, the vast majority of the white employees were bachelors, it became incumbent on those in charge of the work to provide, not only for their ordinary living quarters, but also for ample, well-cooked and served meals for all classes, at the lowest rates that could consistently be given. To this end hotels and eating houses were built, equipped and put in proper running order, at the different localities, wherever necessary. As the result of experiments as to cost of raw food and preparing and serving it, a price was fixed upon for such meals, which, after the natural discussion and criticism bound to follow, was agreed to as being fair and reasonable, and the system moved off satisfactorily.

Previous to this time, I had discussed with the commission at various times the policy of putting all the work of feeding employees into the hands of outside parties. We all realized that next to the all-important matter of sanitation came the problem of caring for the material wants of our men. But as time elapsed, and we began to see light, through the plans we were putting into effect (those for handling the matters directly, ourselves) the question of contracting for the food was held in abeyance until the success or failure of the experiments I was trying was demonstrated.

But at this particular time the commission made a contract with a party, the terms of this contract being practically such as would result in turning over to him all of our carefully installed, elaborate plant, and practically the welfare of the thousands of our employees, subject to restrictions and supervision which in my opinion would have been impracticable to enforce, and would have resulted in certain trouble and confusion. And in addition to this, the contractor was to be allowed to charge employees much larger prices than our own system had demonstrated were necessary.

Immediately I was advised of the terms of this contract I registered a vigorous protest by cable, with the effect that the chairman and contractor came to the isthmus, and after a short conference with the governor, the manager of labor and quarters, and myself, the contract was very wisely abrogated, by mutual consent. Doubtless the commission in making this contract acted only for the best interests of the work from its point of view, but

the results of such action, if carried through, would have precipitated only dissatisfaction and trouble, resulting in serious disruption and lowering of the morale of the force, and would have certainly produced large profits to the contractor at the expense of the employees.

The reconstruction of the Panama Railroad, which was under my management, was a serious problem. It was not, at the time I took charge, able to handle its commercial business, with the additional traffic already thrown onto it, and a very serious state of congestion prevailed. Owing to the delay in deciding upon the type of the canal, it was not possible to rebuild it upon a permanent location; at the same time, the extraordinary amount and variety of service it was called upon to render made quick decision and vigorous action necessary. We were very fortunate in obtaining the services of Mr. W. G. Bierd as superintendent, whose abilities I had clearly recognized while under my jurisdiction in railway work in the States. Plans were made, the work of reconstruction pushed,—hampered all the while by the necessity of handling the constantly increasing traffic—until in 1906 the railroad had been practically rebuilt, double-tracked, supplied with all necessary accessories, including those demanded by food and other supply reception and distribution, and was fully capable of, and did handle satisfactorily, every burden put upon it. We were subjected to criticism and fault-finding, some of it from high sources, that should have been a help instead of an attempted embarrassment; but I kept plugging ahead, disregarding and defying possible consequences to myself, until my judgment was finally conceded to be confirmed by results.

Meanwhile, the commission had reorganized the very inefficient Purchasing and Supply Department, placing at its head, at Washington, Mr. D. W. Ross, to whose able management, hearty and prompt coöperation, I can give only words of praise. All requisitions for supplies, material, plant, tools and thousands of different articles needed were promptly handled, and the Purchasing Department speedily became a help of the right sort, instead of the hindrance it had been in Mr. Wallace's time. In cases where, owing to price or time of delivery, possible changes in specifications looked advisable, the matter was taken up promptly in consultation and agreement arrived at without friction, and in the conducting of all business, particularly through the supply stores on the zone, the greatest harmony prevailed between the departments.

In handling the enormous amounts of money required for payment of salaries and wages on the Isthmus, not only in the actual disbursement of the funds but the methods of timekeeping, identification, etc., leading up to the actual payments, it required the skill and honesty of an unusual man—such a man as Mr. E. J. Williams, who was engaged by the commission for this work. In matters of accounts, etc., he was nominally under the direction of the auditor of the commission, but for the care and legal expenditure of all the funds he was directly responsible in the last analysis only to the Comptroller of the Treasury at Washington. Previous to Mr. Williams taking charge of the disbursement office, things had not apparently moved smoothly in matters of detail on the work, but under the system he put in force satisfaction was given: and that this important feature of the work was well administered is attested by the fact that his services were retained until the completion of the canal. Some of the unnecessarily elaborate plans for accounting, as promulgated by the auditor of the commission at Washington, caused a little friction with the disbursing office, but annoyances of this kind were not allowed to have serious consequences, and fairly harmonious action prevailed between the auditing and the other departments.

The organization of the Engineering Department was framed on simple lines, and generally the material of its personnel

with few additions was found already on the Isthmus. In addition to the staff at general headquarters, there was the Division of Building Construction—Mr. Belding in charge—under which plans were made and construction of all buildings or other structures required by the canal work were carried out, and so successfully that once material began to arrive in sufficient quantities we were able, without serious delay, to properly house and care for the thousands of constantly arriving employees. All the numberless variety of buildings required—quarters, hospitals, schoolhouses, churches, jails, fire and police stations, etc., were promptly erected and put into service. Including the amounts used by the Panama Railroad, over 80,000,000 feet of lumber was brought in from gulf ports and from the Pacific Coast, and all used in the work of this division in a year and a half.

The Division of Municipal Engineering, under Mr. Holcombe, had in its charge all improvements in the nature of sewerage, water supply, paving, street and road making, not only in Panama and Colon but in all the towns in the zone. Its work covered—like that of all the other divisions—a multitude of details, which were well planned and executed.

The Division of Meteorology and River Hydraulics was under the late Mr. Arango, a native of Panama, who was technically educated at one of the prominent engineering schools in the United States. He gave excellent service and was charged with the duties of conducting all stream measurements, of the extensive system of weather recording stations we maintained, not only on the zone, but far distant, up the Chagres River, nearly to the Darien country. Its records of temperature, rainfall, winds, fluctuating flow of streams and seismic disturbances (which were slight, and generally at long distances away) were models of clearness and intelligence, and will become more and more valuable as time goes on.

The maintenance and operation, as far as mechanical features were concerned, of all machinery, was placed under the charge of Mr. Brook, as superintendent of motive power and machinery. Locomotives, steam-shovels, rolling stock, shops, drills and field plant, were planned and built under specifications made by this division, the head of which was held responsible for results. One interesting feature of the work of this division, which I have never seen described in public print, was the planning and building of three immense air-compressing plants, located at about equal distances from each other, from which plants was fed into a pipe line, extending along the entire length of Culebra Cut (nine miles) all the compressed air that was needed to operate the hundreds of air drills employed in the cut. The able work of this division, in planning the necessary plant and tools, was a great factor in enabling the transportation system to be evolved, by which the Culebra Cut was so quickly and economically taken out.

The preparatory work and actual construction of the canal proper was placed under three division engineers. Mr. F. B. Maltby's jurisdiction extended from deep water at Colon to and including all works at Gatun dam, spillway and locks, he also having charge of the construction and maintenance and operation of all marine plant, including dredges, tugs, marine shops, etc. He also planned and erected the elaborate plant which so successfully handled the enormous amount of masonry which was used in the construction of Gatun locks by the army engineers.

The work throughout the famous Culebra Cut was supervised by the division engineer, the late Mr. D. W. Bolich, whose authority extended to and included the locks at Pedro Miguel, including the excavation and disposal of all material from the cut, no matter to what point it was taken. This involved the application of the plan of track installation which I had devised for handling this material, and which plan was followed until the work was completed. From Pedro Miguel locks to deep water in the Bay of Panama, the work was

under Mr. William Gerig as division engineer, and all matters in connection with this section were handled by him, the greater part being the dredging of the outside channel, together with the maintenance and operation of marine shops and plant on his division (as assistant to Mr. Maltby in the last-mentioned work), in which particular lines of employment he was especially qualified. In addition, he conducted all of the vast amount of surveying and test borings, which were needed to arrive at a final decision as to the details of the plan of the canal at its southern end.

These men—in details—laid the foundation upon which was built up the structure, which enabled me to demonstrate that the canal could be built; and not only our success, but the success of those who followed us to the completion of the gigantic work, is debtor to their intelligent, indefatigable labors, in putting into effect the general plans which had been given for their guidance.

I have not touched upon the organization for operation of the Panama Railroad. It was reorganized, and in some ways by drastic treatment, not only in personnel but in methods. Modern systems of accounting and store-keeping were installed, and under the experienced eye of Mr. Bierd—who was later made general manager,—the Panama Railroad became a wonderfully efficient transportation machine. And it had to be, for the amount and variety of service demanded of it cannot be paralleled in the history of the railway world.

The general charge of designing of the dams, locks and spillway was placed in charge of Mr. Joseph Ripley, whose long experience, not only in the construction, but the operation of canals, made his services of immense value. This work was well inaugurated during 1906, and a staff of designers, exceptional in ability, was selected by Mr. Ripley, who worked out all plans of these structures as they were built, with few changes, and which now stand as great monuments to their creative genius.

All this time surveys were being conducted, not only along the line of the canal proper, but elsewhere in the zone for various necessary purposes, such surveys being made in some cases to verify and supplement the records left by the French, but more to obtain exact data required by our accession of the strip of land called the Canal Zone. This work was practically continuous, and it entailed upon the engineers a life of hardship and danger—far in the dense, tropical jungles, miles from the comforts of zone life, and from the protecting ministrations of the Sanitary Department.

The general direction of all of the work of the Engineering Department was supervised and directed from the administration building at Culebra, to which I moved all headquarters—previously located in the City of Panama. At Culebra, Empire, Gorgona, Gatun, Paraiso and Pedro Miguel, we built new large towns, supplied with modern improvements, and smaller ones at many other points, of less importance. A complete system of telephones was installed, so elaborate that, sitting at my desk, I could without delay talk not only with the leading officials wherever located in the zone, but also practically with every switch shanty and steam shovel on the canal. The charge of all office work at headquarters, of correspondence, and largely of executive matters was in the hands of Mr. E. P. Shannon, my faithful and efficient secretary.

Time and space will not here permit the mention personally of the scores of other capable, intelligent, hard-working men who made up the staff of the Engineering Department. They were a fine lot of men, a surprisingly large percentage being graduates of our best colleges and high-grade schools. Almost without exception they seemed to feel that the success of the particular part of the work assigned to them meant the success of

the whole project, and with such a devoted, loyal band of assistants there could be but one result.

It may, I think, be fairly assumed from what has already been said that the position of Chief Engineer was a reasonably busy one, but the conduct and direction of the work so far outlined was only a part of the requirements. The time devoted to the discussion of the type of the proposed canal, both on the Isthmus and in Washington, seemed endless, but the part I took in it, which, without conceit, I think had some influence in the decision made, will ever be a source of gratification to me personally. I went to the Isthmus with a fairly open mind on the subject of type—if anything, rather inclined in favor of the sea level. But it did not take me long to realize that however rich and powerful in men and resources the United States might be, the idea of a sea-level canal, *such as proposed*, was absurd; that a practical one could not be built in any admissible length of time, or without the expenditure of a totally unjustifiable amount of money—enough to stagger even the financial ability of the nation.

So I became an earnest advocate of the present completed lock-type, and reported to the commission strongly in its favor, and both before the International Board of Engineers and committees of both House and Senate, and with individual members of these bodies, earnestly urged its merits; and felt then, and do yet, that the decision which was made in its favor was eminently wise, and that time will so fully demonstrate.

Visits to the States, solely on canal affairs, took up much valuable time which I felt could much better have been devoted to affairs on the Isthmus, but they seemed to be considered necessary, and were made, although several times under protest. It must be remembered that upon me fell the burden, as well as the responsibility, of not only pushing the necessary work of preparation needed to lay a solid foundation for the real work of building the canal, but also, to a great extent, the origination, coincident with the task of organization, of the plans under which the construction of the canal itself was to proceed.

I remarked previously that upon my arrival on the work, little of value had been done on the canal. Doubtless the old commission, in deference to the idiotic howl about "making the dirt fly," had instructed Mr. Wallace to try and do so with the means at hand (for I am convinced that he, of his own volition, would have done no such thing), which meant, with the exception of a few modern steam shovels, he had to resurrect a lot of old, small, and decrepit French plant, and hammer away as best he could. Engines, cars and track were all pitifully ludicrous, and no progress worth the name could be made. Standing on one point, overlooking a part of Culebra Cut, a short time after my arrival, I counted seven work trains in the ditch, and all visible shovels idle. And all available forces of laborers were trying to get these trains on to the tracks, an unwise proceeding, for they were of more value where they were.

I immediately issued orders suspending all and every effort to move material from the cut, organized all these forces into track construction gangs, and as far as material was in hand, laid work tracks of heavy rail, properly ballasted, to conform later to a definite plan I had decided upon, to enable the shovels to work to the best advantage, and the material to be moved most quickly and cheaply. The commission approved my action, and it was carried out, and no more "dirt flew" until the proper preparation had been made. To quote from a letter to a high official, in answer to a request for information on certain matters, I said in relation to my policy—"that if anyone in power realized the absolute necessity of thorough preparation along all lines before attempting to do actual work, he did not have the

courage of his convictions, and did not put such a policy into execution. I have endeavored to do so, and regardless of clamor and criticism, I propose to do so as long as I am in charge of the work. And all the criticism, from any source whatever, of my course in adopting such a policy, will have no effect upon me; and I am confident that if this policy is adhered to, the future will show its absolute wisdom."

The bulk of the common labor being of such a low rate of efficiency, prompt consideration of ways and means to increase the value of these blacks was necessary. From the viewpoint of the white man, the lack of a sufficiently nourishing diet seemed to be largely responsible for their small value. So the experiment was tried of furnishing them, at fair prices, such raw food as suited their needs, and to which their race had for generations been accustomed. In some individual cases an improvement was apparent, but the fact remained that the great bulk of them were, to put it plainly, too indolent to cook the food, preferring to eat raw, such of it as they could. Then we established eating stations, or messes, for all of them, at which places every one, excepting those who were married and living at their homes, were obliged to take their cooked food, the cost of which was deducted from their wages.

The good effect of this move was at once noticeable, and their efficiency increased to a marked degree, and this improvement was enhanced by the introduction of the Spanish, by showing the blacks that they did not control the labor market—as some sort of such hazy idea had gotten into their heads. These negroes are a childlike, amiable sort of people, moral, according to their standards, and easy to control. Those from the British Islands all had a smattering of education, and exhibited it on every occasion. One old man whom I had as a personal servant well illustrated this tendency, when he said: "Mr. Stevens is a fine man, we all love him, but he does not use good English,"—a fact which the patient reader has probably long since discovered.

No serious labor troubles ever occurred during the period in question. One class of our skilled labor, which was enjoying a wage scale that, in addition to the many privileges wisely granted by the commission, really resulted in an advance of more than sixty per cent. above the wages paid for similar work in the States, demanded a very large increase, coupled with the usual threat of a strike, and as a matter of fact some of them did stop working for a few days. This was rather a relief to me, as we were overstocked at that time with this class of men, waiting for necessary preparatory work to be completed.

I refused to make the concessions asked, and plainly told them that our ships were running light, north-bound, and would be glad to fill up their passenger lists. As the Secretary of War, who next to the President had supreme authority over canal affairs, was on the Isthmus, I took up the matter with him, and after due deliberation he sustained my position. The men went back to work, and the incident was closed and remained so during my term of office.

There was a sporadic attempt to make trouble among a fire-eating few of our Spanish laborers, but prompt and drastic action by our zone police put an end to the affair in an hour. Of course, there were the usual malcontents, always present and always vociferous among so many men, but their influence was nil, as far as results were concerned. The whole force —of all classes and races—once living and health conditions became normally what they should be, settled down in a business-like way, and affairs moved off smoothly.

Practically an open door was kept at headquarters for all classes and grades of employees. Complaints and suggestions were listened to patiently at all times, and adjustments were made as equably as possible and did exact justice to all. At

least one-half of my time during daylight hours was spent—generally on foot—along the work and among the labor camps, and my knowledge of the situation was gained very largely by personal contact, and not from routine reports.

During all the time the work of preparation was under way, and coincident with the consideration of the plans under which all phases of the construction was to be carried on, the question of the proper amount and character of the plant which would be required was a pressing and vital matter. The delay in the decision as to the type of the canal was a serious handicap in deciding all of these problems, but once the type was decided upon, then quick action was taken. Vast quantities of all sorts of machinery for all classes of the work, from locomotives to monkey wrenches, track material, steam shovels, cars, and a variety too great to even give a faint suggestion of here, were requisitioned, and for such plants as required special designs, plans and specifications were prepared and orders were placed as soon as the necessary data were available; so that in 1906, enough plant and material had been assembled to enable us to make a real start, not only in Culebra Cut, but also at many other points along the line—notably at Gatun dam and locks and at Pedro Miguel. And the work thus inaugurated during that year went on without cessation, until the completion of all work in 1914.

The relations of the Engineering Department to the various departments under the charge of the governor of the zone were pleasing and harmonious. Especially was this true as regards the policing of the zone, with which we had much to do. Its affairs were administered wisely and firmly and the conduct of all governmental functions contributed much to our progress.

We were thrown often into contact with the officials of the Panama Republic, and speaking for my department, I can truthfully say that we found them a high-grade lot of men, with whom, by the ordinary amenities of life, the most cordial relations could be maintained, and among the many pleasant recollections of a busy life are those of the friendships formed among these people.

It may be thought that in my references to the members of the engineering staff I have pictured them as a very exceptional lot of men. They were not; they were simply a group, truly representative of the best type of educated Americans, who needed only to be shown the way, and to be provided with the proper means to accomplish results; and they did so with an eye single only to the interests of the great project.

I have spoken of the apparent lack of coöperation which existed between the various officials in 1905. To eliminate this discordant note I early instituted weekly meetings, at which were present a representative of every department of the canal, of the Panama Railroad, and the division engineers. At these meetings a general discussion of all work in progress was taken up, and whenever such work was found to interfere with, or to be not in line with the best interests of all departments, adjustments and changes were made, so that these interests were mutually provided for. The same adjustment was made of all work planned to come up in the immediate future, each member of the council being called upon to explain his plans and scope of work, and then and there, any criticisms or suggested changes necessary to conserve the welfare of the work, as a whole, were presented, considered and finally settled. In a word, each official was enabled not only to get a clear idea of the work of his associates and its relation to his own, but also to realize that the interests of his department, however important in his eyes, were but the component parts of a great system, to the successful establishment of which all were mutually interested. The good results coming through these meetings were soon apparent, and thenceforward perfect teamwork became the





1. Lunch time in Culebra Cut; laborers waiting for the work trains.
2. Dining room in one of the "line" hotels.



1. E. J. Williams, Jr., paymaster of the canal, who handled over $250,000,000 in cash.
2. Types of canal workers.
3. Interior of pay car, which carried 1600 pounds of gold and 24 tons of silver coin on each monthly trip.

rule, and it was remarkable how much assistance each could give to the other and to the advancement of his own work.

Owing to the difficulties encountered in securing men of experience for subordinate positions in the early stages of the work, I inclined strongly to the belief that to secure the quickest and most economical results it would be best to place the purely physical parts of it under contract, and on my expressing such views I was requested by the chairman to outline formally such a plan as I might deem practicable, and accordingly I did so.

A careful study of the conditions under which any contract could be entered into and carried out made me absolutely sure that, owing to the multiplicity and variety of details which were known and which must be considered, there would enter into the problem many unknown factors, some of which it would not be practicable to provide for, or even foresee, under any system based upon unit prices. I, therefore, reverted to the well-tried-out plan of contract by percentage, which plan on the whole, when well conceived and honestly executed, is as fair to all interests as can be devised.

My underlying idea was that it might be possible to attract the attention and co-operation of strong railroad and general contractors in the United States, who by combining their strength and influence could form a powerful syndicate, one that not only would command the respect of the business world, but would easily be able, by utilizing their own well-trained forces of experts in all lines of construction, to at once make up an organization composed of the best material that the world afforded. All of these contractors have a following of such men, who are reluctant to leave their service, as I found when trying to build up an independent organization.

After serious study I drew up a plan based upon percentage, under which I considered the interests of both the government and the contractor would be carefully guarded, and every contingency possible to foresee would be provided for. By this plan all governmental and sanitary laws and regulations were to be undisturbed, and the commission, through its chief engineer, was to be to all intents and purposes as much the dictator and arbiter as though the work was to be carried out by its own forces.

The plan was cordially approved without modification by the commission and consideration of it by the higher powers that were was given without delay. But on a trip which I made soon thereafter to Washington, I found that such changes and modifications—mostly of a purely technical character—had been made, that in my opinion would render it unattractive to the class of contractors I desired to interest. However, bids were asked and a few were obtained, none of which were satisfactory in the judgment of all—including myself.

Inasmuch as the objects sought to be accomplished had not been attained, all of the bids were rejected, and decision was made to go on and complete the work with our own forces, which was probably wise. The organization had been so improved and perfected, and such a satisfactory rate of progress was being attained, that it was not thought advisable to incur the certain delay and possible disappointment which another call for bids might entail, as we knew we were certain of success in the handling of the work, as it was then proceeding.

Any present discussion which is being indulged in as to the great superiority of the plan under which the work was done, as compared with what might have been the result if it had been done under contract, is entirely futile. The record is made, as far as the one method is concerned, and only hypothesis and theory can be set forth in regard to the other method, and when such speculations are made by parties having had no practical experience in handling large works by percentage contract, their opinion can

have little weight. I know—from actual experience gained through the expenditure of many millions—that great efficiency and economy will result from such methods properly handled.

In view of the many complimentary remarks passed upon the organization that was finally adopted governing the whole work, I quote below a letter which speaks for itself:

Culebra, August 5, 1906.

Sir:—

In compliance with your instructions, that I outline my ideas as to a proper organization, that will permit the construction of the canal to be carried out in the simplest, quickest, and therefore, best manner, I have the honor to report I have given much thought to the matter and to say,—

I believe that the power and responsibility should be concentrated, not divided; that the commission, constituted in whatever way it may be, must practically be a unit, and as such, must resolve itself into what will amount to a one-man proposition.

That from now on, everything should be made subordinate to construction, and that,—complying, of course, with the law governing,—the members of the commission should be such men as will be in direct charge of, and responsible for, the most important phases of the work, and as far as consistent, they should live on the Isthmus.

That so long as a large commission must be maintained, the division of duties to each other, should be clearly defined, and the chairman should be the responsible head.

That purely Governmental functions should be entirely separated, in theory and practice, from the work of canal building, excepting so far that all officers representing the United States, shall understand that the sole and only object they have in holding office and living on the Isthmus, is to enable the United States to build and operate the canal.

I have, in consultation with Chairman Shonts, thoroughly threshed over these matters, and wish to say I am entirely in accord with him, and that I believe an organization along the lines we have drawn up, a draft or outline of which he takes to the States with him tomorrow, is the best and strongest that can be devised.

While the canal may be paid for by the eighty odd millions of the people of the United States, the construction of it can be successfully carried on only under the supervision of a very limited number of them.

Respectfully yours,

JNO. F. STEVENS,
Chief Engineer.

THE PRESIDENT,
Oyster Bay,
N. Y.

It will be seen, I think, that there is a striking similarity in the suggestions outlined in this letter, and the plan that was put into effect at a later date. And the remark in the letter, that I collaborated with any one in drafting it, was a polite fiction, excusable perhaps, for reasons of policy, which seemed desirable to maintain.

I have heretofore referred to the fact that I always had the approval and cordial support of the commission in whatever I undertook and carried out, and without such help, of course the results achieved could not have been attained. In so far as this, the commission is entitled to great credit, but I want distinctly to state that, as far as the Engineering Department was concerned, all its plans, including the securing of labor of all classes, the housing, supplying and feeding of the same, the designing and the ordering of all plant, the conception of how the work, both preparatory and permanent, should be carried out, were made and executed on the Isthmus, by that department, within itself, and not by the commission. And I fail to recall even a suggestion in reference to any important matter, much less an order, which was ever given out by that body, in regard to, or governing in any way, the methods we pursued in planning or carrying out the work, with the exception of the one concerning the unfortunate food contract, to which I have alluded.

Possibly, such a policy would not have succeeded if the personnel had been different. I knew I had a staff that could be depended upon, not only to loyally and efficiently carry out any plan given to it, but also to suggest and originate plans, when its members found that they were expected to do so, as a part of their duties. And I have always been ready, and I am yet, to assume the entire responsibility for what we did, and to smile at the "damning by faint praise," and the efforts of interested parties to ignore the truth, and to seize all the glory that is so liberally exhibited to the public.

During my time as chief engineer, I had much direct association with both the President and Secretary of War, and never for a moment did either fail to give me

the most whole-hearted support and encouragement. They both realized the serious nature of the problem, and the aid they extended was of the greatest service to me.

President Roosevelt's ideas always furnished food for thought, and the suggestion that we place our clubhouses under the management of the Y. M. C. A. was one of his happiest. It came to me from him, and so I give to him the credit.

Our relations were always harmonious, and are yet, and all statements to the contrary, which have been published by irresponsible writers, are entirely erroneous. I am betraying no confidence when I say I knew that under the plan of organization I have referred to, every interest would have been placed in my hands, should I have so desired. And when, for purely personal reasons, I tendered my resignation as chief engineer, I did it unreservedly, and not with any string, or attempted bluff, as was reported. The President was not a man to be bluffed, even if my respect for his high office, as well as my regard for him personally, would have permitted any such preposterous action. My reasons for resigning were purely personal, and for nothing whatever in regard to the canal, its organization, or any one in any way connected with it.

And, as to having been hampered by so-called red tape or Washington ways of doing business, I think I have made it clear that nothing of the kind ever occurred in my experience. I have explained the relations I held with the commission; and with the President and Secretary of War, it was always a case of "cut the corners," to an extent which made it a positive pleasure to do business with them.

The attitude of the great majority of our newspapers was very friendly toward us, when represented by their regular correspondents, who were a high-grade class of men, and whose reports were always made up as the result of their own observations. To me personally they were more than kind, and I feel that much of our success was due to their intelligent work. They were free in criticism when occasion justified, and as equally free in commendation of methods and results which proved worthy.

Of the work of Colonel Goethals and his corps of efficient assistants, of course nothing but words of praise can be given. It has always been a source of gratification to me that the management of canal affairs fell into the hands of an able man, one who had the breadth of mind which enabled him to give credit to those who preceded him, which he has done on many occasions. The manner in which the completion of the gigantic work was carried out was a great triumph for American men and methods.

We handed over to the army engineers a well-planned and built machine, one that was running fairly smoothly, with perhaps a squeak or a hot bearing here and there, as is always inevitable with new machinery. Improvements in detail could be and were made, as would have been the case no matter who had been the engineer. But the fact remains that no radical change was made in any of its component parts, and that it proved such a success was no surprise whatever to me. It was probably wise to place the work in 1907 in the hands of the army engineers, in order to secure certain continuity of supervision, which as events had proved could not be relied upon without so doing. But it is well known to many that it would have been entirely possible to have quickly secured men in civil life, who could have carried the work on as rapidly and as economically as did the army men.

This statement does not imply any disparagement of the work of Colonel Goethals, or of his staff. A good executive, with an ample experience in construction, possessed of a clear head and a strong arm, could have turned the crank and ground out as finished and complete a result as has been achieved. If I had not been fully aware of this, when I resigned, I should have remained in charge.

During the last year of my service, and at times since, I have received many letters and verbal comments—all unsolicited, of course,—from men of every walk in life, all very complimentary in character as to our work. And with the certain penalty of being accused of a lack of modesty, I quote one letter here, as showing that occasionally a ray of light from the outside illumined the dark places. I do this, because I know the kind words were intended to apply, not so much to me personally, as to the Engineering Department, of which I happened to be the head. And while it is a voice from the Great Beyond, it will appeal to many who knew the writer to be sincere in whatever he said:

Hotel Tivoli, Ancon, Canal Zone,
March 16, 1906.

Mr. John F. Stevens.

Dear Sir: Fearing I may not see you before we sail, I want to write a word of appreciation of your splendid work here on the Isthmus. I had not the faintest conception of it before I came here. I can imagine something of the chaos that existed when you came here; but the order which you have brought out of the confusion is marvelous. Your organization is most complete. You have proven yourself not only an engineer of the highest rank, but an able and thorough executive. The world will some day realize the debt of gratitude it owes to John F. Stevens.

With best wishes for your future, I am,

Yours very truly,

SERENO E. PAYNE.

In looking back over the events which took place during my time of service with the Panama Canal, and of which I had a hand in shaping, I can see some which could have been better met, and many that satisfy me in their outcome. And I know full well that when all motives, actions and results are subjected to the melting pot of time, when "the tumult and the shouting dies, the Captains and the Kings depart," each and every one who had his share, small or great, in the wonderful enterprise, will be given the true place in history to which his work entitles him.

CHAPTER XXXVIII

HOW THE UNITED STATES ACQUIRED THE RIGHT TO DIG THE PANAMA CANAL*

FORMER PRESIDENT ROOSEVELT'S OWN VERSION OF HIS NEGOTIATIONS WITH COLOMBIA—DEALINGS WITH THE FRENCH COMPANY—COLOMBIA REJECTS HAY-HERRAN TREATY—REVOLUTION AT PANAMA A FOREGONE CONCLUSION—AMERICAN NAVAL FORCES KEEP TRANSIT OPEN AND PREVENT COLOMBIAN TROOPS FROM LANDING—NEW REPUBLIC RECOGNIZED AND TREATY CONCLUDED WITH IT—UNITED STATES OFFERS COMPENSATION TO COLOMBIA THROUGH A TRIPARTITE TREATY, WHICH COLOMBIA REJECTS.

BY THEODORE ROOSEVELT

NO OTHER great work now being carried on throughout the world is of such far-reaching and lasting importance as the Panama Canal. Never before has a work of this kind on so colossal a scale been attempted. It is worth while to remember just how it was that America won for itself and the world the right to do a world-job which had to be done by some one, and the doing of which by anyone else would have been not merely a bitter mortification but a genuine calamity to our people.

On December 7, 1903, and again on January 4, 1904, as President of the United States, in messages to the two houses of Congress, I set forth in full and in detail every essential fact connected with the recognition of the Republic of Panama, the negotiation of a treaty with that Republic for building the Panama Canal, and the actions which led up to that negotiation—actions without which the canal could not have been built, and would not have been even begun. Not one important fact was omitted, and no fact of any importance bearing upon the actions or negotiations of the representatives of the United States not there set forth has been, or ever will be, discovered, simply because there is none to discover. It must be a matter of pride to every honest American, proud of the good name of his country, that the acquisition of the canal and the building of the canal, in all their details, were as free from scandal as the public acts of George Washington and Abraham Lincoln.

The facts were set forth in full at the time in the two messages to which I have referred. I can only recapitulate them briefly, and in condensed form. Of course there was at the time, and has been since, much repetition of statements that I acted in an "unconstitutional" manner, that I "usurped authority" which was not mine. These were the statements that were made again and again in reference to almost all I did as President that was most beneficial and most important to the people of this country, to whom I was responsible, and of whose interests I was the steward. The simple fact was, as I have elsewhere said, that when the interest of the American people imperatively demanded that a certain act should be done, and I had the power to do it, I did it unless it was specifically prohibited by law, instead of timidly refusing to do it unless I could find some provision of law which rendered it imperative that I should do it. In other words, I gave the benefit of the doubt to the people of the United States, and not to any group of bandits, foreign or domestic, whose interests happened to be adverse to those of the people of the United States. In my judgment, history had taught the

*By special permission of the Outlook Company and Theodore Roosevelt.

lesson that the President has very great powers if he chooses to exercise those powers; but that, if he is a timid or selfish man, afraid of responsibility and afraid of risks, he can of course manufacture ingenious excuses for failure to exercise them. At a great crisis in American history Mr. Buchanan had shown himself to belong to the latter type of President; Mr. Lincoln had represented the other type, the type which gave the people the benefit of the doubt, which was not afraid to take responsibility, which used in large fashion for the good of the people the great powers of a great office. I very strongly believed that Abraham Lincoln had set the example which it was healthy for the people of the United States that other Presidents should follow.

For many years prior to 1903 our Government had been negotiating with foreign powers to provide for the building of a Panama Canal. By 1902, on the conclusion of the Hay-Pauncefote Treaty, we had cleared the way sufficiently to enable Congress to pass an Act actually providing for the construction of a canal across the isthmus. By this Act the President was authorized to secure for the United States the property of the French Panama Canal Company and the perpetual control of a strip of territory across the Isthmus of Panama from the Republic of Colombia within a reasonable time and at a reasonable price, and, if the endeavor failed, the adoption of the Nicaragua route was authorized.

In October and November, 1903, events occurred on the Isthmus of Panama which enabled me, and which made it my highest duty to the people of the United States, to carry out the provisions of the law of Congress. I did carry them out, and the canal is now being built because of what I thus did. It is also perfectly true that, if I had wished to shirk my responsibility, if I had been afraid of doing my duty, I could have pursued a course which would have been technically defensible, which would have prevented criticism of the kind that has been made, and which would have left the United States no nearer building the canal at this moment than it had been for the preceding half-century. If I had observed a judicial inactivity about what was going on at the isthmus, had let things take their course, and had then submitted an elaborate report thereon to Congress, I would have furnished the opportunity for much masterly debate in Congress, which would now be going on—and the canal would still be fifty years in the future.

The interests of the American people demanded that I should act just exactly as I did act; and I would have taken the action I actually did take even though I had been certain that to do so meant my prompt retirement from public life at the next election; for the only thing which makes it worth while to hold a big office is taking advantage of the opportunities the office offers to do some big thing that ought to be done and is worth doing.

Under the terms of the Act the Government finally concluded a very advantageous agreement with the French Canal Company. The French Company had spent enormous sums on the isthmus. We felt justified in paying the company only a very small fraction of what it had thus spent. The treaty we made was advantageous to us in a very high degree, and we got what in value was much more than what we paid for it; but the French Company did get something, and if we had not stepped in it would have gotten absolutely nothing. Every step taken by the Government in connection with its negotiations with the French Company and the payment to its official representatives in accordance with the agreement entered into was taken with the utmost care, and every detail has been made public. Every action taken was not merely proper, but was carried out in accordance with the highest, finest, and nicest standards of public and governmental ethics. Doubtless in Paris, and perhaps to a lesser extent in New York, there were speculators who bought and sold in the stock market with a view to the varying

conditions apparent from time to time in the course of the negotiations, and with a view to the probable outcome of the negotiations. This was precisely what speculators did in England in connection with the outcome of the Battle of Waterloo, and in our own country in connection with Abraham Lincoln's issuance of the Emancipation Proclamation and other acts during the Civil War.

The rights of the French Company having been acquired, and the difficulties caused by our previous treaties having been removed by the Hay-Pauncefote Treaty, there remained only the negotiations with the Republic of Colombia, then in possession of the Isthmus of Panama. Under the Hay-Pauncefote Treaty it had been explicitly provided that the United States should build, control, police, and "protect" (which incidentally means to fortify) the canal. The United States thus assumed complete responsibility for, and guaranteed the building of, the canal. Nearly fifty years before, our Government had announced that it would not permit the country in possession of the isthmus "to close the gates or interfere" with opening one of the "great highways of the world," or to justify such an act by the pretension that this avenue of trade and travel belonged to that country and that it chose to shut it. We had always insisted upon the doctrine thus declared, and at last the time had come when I could reduce it to action. We negotiated with the representatives of Colombia a treaty for building the canal, a treaty which granted to Colombia even greater advantages than were subsequently granted to the Republic of Panama, a treaty so good that after it had been rejected by Colombia, and after we had recognized Panama, Colombia clamored for leave to undo the past and enter into the treaty. But the Colombian Government, for reasons which, I regret to say, were apparently very bad indeed, declined to consummate the treaty to which their representatives had agreed. The Isthmus of Panama was then a part of the Colombian Republic, and the representatives of Panama in the Colombian Legislature at once warned Colombia that the people of Panama would not submit quietly to what they regarded as an utter ignoring of their vital interests. We also, courteously and diplomatically, but emphatically, called the attention of the Colombia representatives to the very serious trouble they were certain to bring upon themselves if they persisted in their action. I felt very strongly that the position that the one-time Secretary of State, Cass, had taken nearly fifty years before was the proper position, and that the United States would be derelict to its duty if it permitted Colombia to prevent the building of the Panama Canal. I was prepared, if necessary, to submit to Congress a recommendation that we should proceed with the work in spite of Colombia's opposition, and indeed had prepared a rough draft of a message to that effect, when events on the isthmus took such shape as to change the problem.

The isthmus was seething with revolutionary spirit. The central government of the Republic of Colombia was inefficient and corrupt. Lawlessness had long been dominant in every branch. During a period of something like seventy years there had been only one or two instances in which a president had served out his term. The republic had repeatedly undergone internal convulsions which completely changed its aspect. Our Government first entered into a treaty with the possessors of the isthmus of Panama in 1846. At that time the nation with which we treated was known as New Granada. After a while New Granada split up and the Republic of Colombia, another confederation, took its place; and Panama was at one time a sovereign state and at another time a mere department of the consecutive confederations known as Colombia and New Granada. In addition to scores of revolutions which affected successively New Granada and Colombia as a whole, the Isthmus of Panama during fifty-seven years saw fifty-three revolutions,

rebellions, insurrections, civil wars, and other outbreaks; some of the revolutions being successful, some unsuccessful; one civil war lasting nearly three years, and another nearly a year. Twice there had been attempted secessions of Panama, and on six different occasions the marines and sailors from United States war-ships were forced to land on the isthmus in order to protect property and to see that transit across the isthmus was kept clear, a duty we were by treaty required to perform, for by treaty we already possessed and exercised on the isthmus certain proprietary rights and sovereign powers which no other nation possessed. On four different occasions the Government of Colombia itself requested the landing of troops to protect its interests and to maintain order on the isthmus—the order which it was itself incompetent to maintain. On several different occasions only the attitude of the United States prevented European powers from interfering on the isthmus. In short, Colombia had shown itself utterly incompetent to perform the ordinary governmental duties expected of a civilized state; and yet it refused to permit the building of the canal under conditions which would have perpetuated its control of the isthmus, and which would at the same time have put a stop to what can legitimately be called government by a succession of banditti. The United States would have shown itself criminal, as well as impotent, if it had longer tolerated this condition of things.

I was prepared to advocate our openly avowing that the position had become intolerable, and that, in pursuance of our duty to ourselves as well as to the world, we should begin the building of the canal. But my knowledge—a knowledge which, as regards most of the essential points, was shared by all intelligent and informed people—of the feeling on the isthmus was such that I was quite prepared to see the people of the isthmus themselves act in such a way as to make our task easier. They felt that it was of vital importance to them to have the canal built, for they would be its greatest beneficiaries; and therefore they felt such bitter indignation at Colombia's indifference to their interests and refusal to permit the fruition of their hopes that among them there was a literally unanimous desire for independence. Not only was there not a single man on the isthmus who wished to perpetuate Colombian control, but all Colombians sent hither, even the soldiers, after a very short residence grew to share the desire of all Panamans for the establishment of a separate republic. Hitherto the knowledge that the United States would interfere to stop all disturbances on the isthmus that interrupted traffic across it had resulted to the benefit of Colombia; and it was this knowledge that had been the chief preventive of revolutionary outbreak. The people of Panama now found themselves in a position in which their interests were identical with the interests of the United States; for the Government of Colombia, with elaborate care, and with a shortsightedness equal to its iniquity, had followed out to its end the exact policy which rendered it morally impossible as well as morally improper for the United States to continue to exercise its power in the interest of Colombia, and against its own interest and the interest of Panama. There was no need for any outsider to excite revolution in Panama. There were dozens of leaders on the isthmus already doing their best to excite revolution. It was not a case of lighting a fuse that would fire a mine—there were dozens of such fuses being lit all the time; it was simply a case of its ceasing to be the duty of the United States to stamp on these fuses, or longer to act in the interest of those who had become the open and malignant foes of the United States—and of civilization and of the world at large.

Every man who read the newspapers knew that with the failure of Colombia to ratify the Hay-Herran Treaty revolutionary attempts became imminent on the isthmus. The papers published on the







1. Hotel Washington at Colon.
2. Panama Railroad Station at Panama.
3. Hotel Tivoli, at Ancon, social headquarters on the Isthmus.

isthmus themselves contained statements that these revolutions were about to occur, and these statements were published in the Washington and New York and New Orleans papers. From these published statements it appeared that, if the canal treaty fell through, a revolution would in all probability follow, that hundreds of stacks of arms were being imported, that the government forces in Panama and Colon were themselves friendly to the revolution, and that there were several distinct and independent centers of revolutionary activity on the isthmus. It was also announced that the government at Colombia was hurrying preparations to send troops to Panama to put down the revolution. Of course I did not have to rely merely upon what I saw in the newspapers. From various sources I had gathered enough to satisfy me that the situation was at least as bad as the papers depicted it. Through two army officers who had visited the isthmus in September I gained concrete and definite information. They informed me that, owing to the dissatisfaction because of the failure of Colombia to ratify the Hay-Herran Treaty, a revolution was certain to break out on the isthmus, and that the people were in favor of it, and that it might be expected immediately on the adjournment of the Colombian Congress without ratification of the treaty. In response to my questioning, they said they were certain that a revolution—several different revolutionary movements were being planned independently of one another—would occur immediately after the adjournment of the Colombian Congress in October; while on the isthmus they had calculated that it would not occur until after October 20, because not until then would a sufficient quantity of arms and munitions have been landed to supply the revolutionaries. Acting in view of all these facts, I sent various naval vessels to the isthmus. The orders to the American naval officers were to maintain free and uninterrupted transit across the isthmus, and, with that purpose, to prevent the landing of armed forces with hostile intent at any point within fifty miles of Panama. These orders were precisely such as had been issued again and again in preceding years —1900, 1901, and 1902, for instance. They were carried out. Their necessity was conclusively shown by the fact that a body of Colombian troops had landed at Colon and threatened a reign of terror, announcing their intention of killing all the American citizens in Colon. The prompt action of Captain Hubbard, of the gunboat *Nashville*, prevented this threat from being put into effect; he rescued the imperiled Americans, and finally persuaded the Colombian troops to reëmbark and peacefully return to Colombia.

With absolute unanimity the people of the isthmus declared themselves an independent republic, and offered immediately to conclude with our Government the treaty which Colombia had rejected, and to make its terms somewhat more favorable to the United States. No bloodshed whatever had occurred, and it could not occur unless we permitted Colombian troops to land. The Republic of Panama was the *de facto* government, and there was no other on the isthmus. There were therefore two courses open to us. One was to turn against the people who were our friends, to abandon them, and permit the people who were our foes to reconquer Panama with frightful bloodshed and destruction of property, and thereby to reëstablish and perpetuate the anarchic despotism of the preceding fifty years—inefficient, bloody, and corrupt. The other course was to let our foes pay the penalty of their own folly and iniquity and to stand by our friends, and, as an incident, to prevent all bloodshed and disturbance on the isthmus by simply notifying Colombia that it would not be permitted to land troops on Panama. Of course we adopted the latter alternative. To have adopted any other course would have been an act not merely of unspeakable folly but of unspeakable baseness; it would have been even more ridiculous than infamous. We recognized the Republic of

Panama. Without firing a shot we prevented a civil war. We promptly negotiated a treaty under which the canal is now being dug. In consequence Panama has for eight years enjoyed a degree of peace and prosperity which it had never before enjoyed during its four centuries of troubled existence. Be it remembered that unless I had acted exactly as I did act there would now be no Panama Canal. It is folly to assert devotion to an end, and at the same time to condemn the only means by which the end can be achieved. Every man who at any stage has opposed or condemned the action actually taken in acquiring the right to dig the canal has really been the opponent of any and every effort that could ever have been made to dig the canal. Such critics are not straightforward or sincere unless they announce frankly that their criticism of methods is merely a mask, and that at bottom what they are really criticising is having the canal dug at all.

The United States has done very much more than its duty to Colombia. Although Colombia had not the slightest claim to consideration of any kind, yet, in the interests of Panama, and so as to close all possible grounds of dispute between Panama and Colombia, the United States some time ago agreed to a tri-party treaty between herself, Colombia, and Panama, by which, as a simple matter of grace and not of right, adequate and generous compensation would have been given Colombia for whatever damage she had suffered; but Colombia refused to agree to the treaty. On this occasion, in my judgment, the United States went to the very verge of right and propriety in the effort to safeguard Panama's interests by making Colombia feel satisfied. There was not the slightest moral obligation on the United States to go as far as she went; and at the time it seemed to me a grave question whether it was not putting a premium upon international blackmail to go so far. Certainly nothing more should be done. There is no more reason for giving Colombia money to soothe her feelings for the loss of what she forfeited by her misconduct in Panama in 1903 than for giving Great Britain money for what she lost in 1776. Moreover, there is always danger that in such cases an act of mere grace and generosity may be misinterpreted by the very people on whose behalf it is performed, and treated as a confession of wrongdoing. We are now so far away from 1776 that this objection does not apply in that case, and there would be no particular reason why any sentimental persons who feel so inclined should not agitate to have Great Britain paid for the nervous strain and loss of property consequent upon our action in that year and the immediately subsequent years. But we are still too near the Panama incident to be entirely certain that base people would not misunderstand our taking such action in her case; and as there was literally and precisely as much moral justification for what we did in Panama in 1903 as for what we did in our own country in 1776—and indeed even more justification—it is as foolish now to claim that Colombia is entitled, or ever has been entitled, to one dollar because of that transaction as to claim that Great Britain is entitled to be compensated because of the Declaration of Independence.

Not only was the course followed as regards Panama right in every detail and at every point, but there could have been no variation from this course except for the worse. We not only did what was technically justifiable, but we did what was demanded by every ethical consideration, national and international. We did our duty by the world, we did our duty by the people of Panama, we did our duty by ourselves. We did harm to no one save as harm is done to a bandit by a policeman who deprives him of his chance for blackmail. The United States has many honorable chapters in its history, but no more honorable chapter than that which tells of the way in which our right to dig the Panama Canal was secured and of the manner in which the work itself has been carried out.

CHAPTER XXXIX

PANAMA CANAL LEGISLATION

Reasons for Constructing the Canal—The Spooner Act—Authority for Purchase of Canal Property and Acquisition of Canal Zone—Alternate Route Authorized—Revolution of Panama Results in New Treaty—Congress Appropriates Money—Provides for a Lock Canal—Fortifications Authorized—Permanent Government Act—Canal Commission Superseded—President Authorized to Fix Tolls—Far-Reaching Legislation Affecting Railroad-Owned Vessels and Powers of Interstate Commerce Commission—Controversy Over Tolls on American Coastwise Vessels—The Repeal Act—Foreign Vessels Admitted to American Registry.

By J. Hampton Moore

Member of Congress from Pennsylvania

BY what legal processes did the United States come to secure possession of the Panama Canal property and what means did it employ to complete the work of construction and to organize the government now in control at the Isthmus?

The story of the pioneers has been told; the brilliant and tragic achievements of the explorers have filled innumerable volumes, and each succeeding story heightens the general interest in the great scheme of uniting the waters of the Atlantic and Pacific in liquid wedlock. More prosaic than the tales of Balboa the discoverer, of Morgan the buccaneer, or of de Lesseps, the promoter, but equally essential to the practical accomplishment of the great dream of the ages, was the work of the statesmen in the American Congress who devised the plan and provided the means for attaining the result on the basis of law. It is easy to sit upon the hilltop and dream of the union of rivers that glisten in the valley below, but the marshalling of the men and the money to engage in so vast an undertaking was anything but a day-dream. To draw the plans by which a given number of cubic yards of earth could be removed from a given area was probably the easiest step in the work of constructing the canal; it is a vastly different thing to provide the equipment, and to secure the army of workers sufficient to surmount the difficulties existing in so unhealthy an environment, thousands of miles from the base of supplies.

The early surveys afforded every opportunity for individuals or nations to enter into the work of canal construction either at Nicaragua or at Panama. The daring, but unsuccessful, effort of the French company under de Lesseps supplied the American Congress with ample information as to the breakers ahead. It is still a disputed question whether the historic voyage of the *Oregon* was responsible for the desire of the American people to undertake the work of canal construction. Commercial expansion, or the desire to figure in the world's trade, undoubtedly had much to do with it. Later on, when the question of fortification arose, it was evident that the military and naval advantages of the canal had been considered among the reasons for its acquisition and construction.

When at last the people of the United States were ready to build a canal, the preparation of the necessary legislation was begun in both Houses of Congress. The distinguished Iowan, Colonel William

P. Hepburn, who under the lamented McKinley, was chairman of the Committee on Interstate and Foreign Commerce, a committee having jurisdiction over matters of this kind, introduced a bill looking to canal construction, and so did the learned Senator from Wisconsin, the Hon. John C. Spooner, who was then at the head of the Senate Committee having jurisdiction in such cases.

If the United States was to go into the canal business, it must necessarily have a start warranted by law, and after long discussions in committee and in conference and upon the floor of the Senate and House, the basic law which has since been called the Spooner Act was passed, and signed by President Roosevelt, June 28, 1902. Although induced to some extent by the Hay-Pauncefote Treaty of February 22, 1902, and modified in certain particulars by subsequent legislation, this act, the title of which is "To provide for the construction of a canal connecting the waters of the Atlantic and Pacific Oceans," may be regarded as the organic law of the Panama Canal. And it is worthy of comment that although the estimated sum of money appropriated in the Act of June 28, 1902, for the purchase and construction of the canal, has been greatly exceeded by subsequent appropriations, the object set forth in the Act, to wit, the construction of a canal connecting the waters of the Atlantic and Pacific Oceans, was prosecuted with such intelligence and vigor that in twelve years from the date of the passage of the Act, the monumental work which had been dreamed of through the centuries and upon which other nations had expended years of toil and innumerable lives, had been completed, and, in effect, dedicated to the commerce of the world.

It may be left to others to enlarge upon the controversies ensuing from interpretations of the Clayton-Bulwer and Hay-Pauncefote treaties with Great Britain. They had to be considered by our national legislators in reaching a basis for proceeding lawfully to the acquisition of the canal. It is generally conceded that without the Hay-Pauncefote treaty, this country must have undertaken to construct a canal such as was contemplated, in violation of the troublesome convention known as the Clayton-Bulwer treaty, made back in 1850, when conditions were radically different from those succeeding the Spanish-American War. The chief objection to the United States assuming the work, however, was removed by the Hay-Pauncefote treaty when, in Article 2, it was agreed

"that the canal may be constructed under the auspices of the government of the United States, either directly at its own cost, or by gift or loan of money to individuals or corporations, or through subscription to or purchase of stock or shares, and that, subject to the provisions of the present treaty, the said government shall have and enjoy all the rights incident to such construction, as well as the exclusive right of providing for the regulation and management of the canal."

This waiver having been obtained from Great Britain, the Congress of the United States was in a position to proceed to negotiate for the property of the Panama Canal Company, or for an alternative route by way of Nicaragua. It is noticeable that while Congress had in mind the taking over of the property of the French Company at Panama, it threw an anchor to windward, so that in the event of the failure of negotiations for the project of de Lesseps, the commission appointed by the Act could proceed to negotiate for "a ship canal and waterway from a point on the shore of the Caribbean Sea near Greytown, by way of Lake Nicaragua, to a point near Brito on the Pacific Ocean."

Taking the Act of June 28, 1902, as the organic law of the Panama Canal, let us see what the legislative mind had in view at the inception of the project. First, the President of the United States was authorized to acquire

"for and on behalf of the United States, at a cost not exceeding forty millions of dollars, the rights, privileges, franchises, concessions, grants of land, right of way, unfinished work, plants, and other property, real, personal, and mixed, of every name and nature, owned by the New Panama Canal Company, of France, on the Isthmus of Panama, and all its maps,

plans, drawings, records on the Isthmus of Panama and in Paris, including all the capital stock, not less, however, than sixty-eight thousand eight hundred and sixty-three shares of the Panama Railroad Company, owned by or held for the use of said canal company, provided a satisfactory title to all of said property can be obtained."

That was the first step by which, under the Hay-Pauncefote treaty, the canal was to be constructed "under the auspices of the government of the United States." And, after appropriate negotiations, the French rights and titles were turned over to the United States.

The second section of the organic act authorized the President, who at that time was Mr. Roosevelt,

"to acquire from the Republic of Colombia, for and on behalf of the United States, upon such terms as he may deem reasonable, perpetual control of a strip of land, the territory of the Republic of Colombia, not less than six miles in width, extending from the Caribbean Sea to the Pacific Ocean, and the right to use and dispose of the waters thereon, and to excavate, construct, and to perpetually maintain, operate, and protect thereon a canal, of such depth and capacity as will afford convenient passage of ships of the greatest tonnage and draft now in use, from the Caribbean Sea to the Pacific Ocean, which control shall include the right to perpetually maintain and operate the Panama Railroad, if the ownership thereof, or a controlling interest therein, shall have been acquired by the United States, and also jurisdiction over said strip and the ports at the ends thereof to make such police and sanitary rules and regulations as shall be necessary to preserve order and preserve the public health thereon, and to establish such judicial tribunals as may be agreed upon thereon as may be necessary to enforce such rules and regulations."

In the third section it was provided

"That when the President shall have arranged to secure a satisfactory title to the property of the New Panama Canal Company, as provided in section one hereof, and shall have obtained by treaty control of the necessary territory from the Republic of Colombia, as provided in section two hereof, he is authorized to pay for the property of the New Panama Canal Company forty millions of dollars and to the Republic of Colombia such sum as shall have been agreed upon, and a sum sufficient for both said purposes is hereby appropriated, out of any money in the Treasury not otherwise appropriated to be paid on warrant or warrants drawn by the President."

Thus provision was made for the purchase money, the expenditure of which would clear the track for the actual work of digging and construction. Section 3, having conferred authority upon the President to acquire the necessary rights and titles, proceeded to direct him "through the Isthmian Canal Commission," for which provision was subsequently made, to

"cause to be excavated, constructed, and completed, utilizing to that end as far as practicable the work heretofore done by the New Panama Canal Company, of France, and its predecessor company, a ship canal from the Caribbean Sea to the Pacific Ocean."

Then followed legislative instructions indicating that Congress at that time had in mind the construction of a canal equal in dimensions to any in existence, and capable of passing the largest vessels afloat. Here is the exact language of the law:

"Such canal shall be of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draft now in use, and such as may be reasonably anticipated, and shall be supplied with all necessary locks and other appliances to meet the necessities of vessels passing through the same from ocean to ocean; and he shall also cause to be constructed such safe and commodious harbors at the termini of said canal, and make such provisions for defense as may be necessary for the safety and protection of said canal and harbors. That the President is authorized for the purposes aforesaid to employ such persons as he may deem necessary, and to fix their compensation."

Having thus mapped out a course of action for the President and having thus supplied him, as it were, with the ways and means to proceed with the great business in hand, Congress wisely set up an alternative course of action. The whole of section 4 of the organic law relates to a possible recourse of the President in the event of the failure of negotiations with the French concessionaires, or with Colombia, or any other country, over the Panama property. What if the French should decline the $40,000,000? was evidently the thought running through the mind of Congress; or What if Colombia, which assumes jurisdiction over Panama, should become obstinate or balk at the terms which the United States shall offer? It is not the purpose of this chapter to deal with the Colombian controversy that arose after the Panama revolution, or to dwell

in detail upon the negotiations between the President's representatives and the French interests. It may be observed, however, that while the two parties were brought to a speedy agreement as to the value of the French rights and titles, the revolution of Panama, which was probably not foreseen by the framers of the Spooner Act, did bring on a controversy which has not yet been settled to the satisfaction at least of Colombia.

Whether the lawmakers feared the outcome of negotiations with Colombia or not, the fact remains that they desired the President to have a free hand to quit Panama and Colombia, if the terms and conditions became unreasonable, and go elsewhere. The recent Colombian contention that Colombia ought to be paid for certain rights it claimed to possess before the Panama revolution and the negotiations had by President Roosevelt with the Republic of Panama as an independent country, show that the congressional plans were not without good reason.

Remembering that sections 1, 2, and 3, related to the Panama Canal and the accompanying rights and privileges exclusively, and contemplated purchase and construction at that point, section 4 looms up as a saving clause against extortion, misunderstanding, or delay. "We desire to do business at Panama," said Congress, "but if you will not sell, or if you become extortionate, then we will leave you and take up the great work of uniting the oceans at another place."

"Should the President be unable," said section 4,

"to obtain for the United States a satisfactory title to the property of the New Panama Canal Company and the control of the necessary territory of the Republic of Colombia and the rights mentioned in sections one and two of this Act, within a reasonable time and upon reasonable terms, then the President, having first obtained for the United States perpetual control by treaty of the necessary territory from Costa Rica and Nicaragua, upon terms which he may consider reasonable, for the construction, perpetual maintenance, operation, and protection of a canal connecting the Caribbean Sea with the Pacific Ocean by what is commonly known as the Nicaragua route, shall through the said Isthmian Canal Commission cause to be excavated and constructed a ship canal and waterway from a point on the shore of the Caribbean Sea near Greytown, by way of Lake Nicaragua, to a point near Brito on the Pacific Ocean."

And if the Nicaragua route were chosen, then the Isthmian Canal Commission was to make the necessary surveys and proceed to the work of construction so that at Nicaragua a canal of dimensions equal to those contemplated for the Panama route should be provided.

The question of Panama or an alternate route being thus provided for, an appropriation of $10,000,000 was set down in section 5 "toward the project herein contemplated by either route so selected." "And," continued this section,

"the President is hereby authorized to cause to be entered into such contract or contracts as may be deemed necessary for the proper excavation, construction, completion, and defense of said canal, harbors, and defenses, by the route finally determined upon under the provisions of this Act. Appropriations therefor shall from time to time be hereafter made, not to exceed in the aggregate the additional sum of one hundred and thirty-five millions of dollars should the Panama route be adopted, or one hundred and eighty millions of dollars should the Nicaragua route be adopted."

As a concession to the Republic of Colombia or to the States of Nicaragua or Costa Rica, should any agreement be entered into with them, the President was authorized by section 6 to guarantee to either of them "the use of said canal and harbors, upon such terms as may be agreed upon, for all vessels owned by said states or by citizens thereof."

The appointment of the Isthmian Canal Commission was provided for in Section 7. This commission was to be composed of seven members to be nominated and appointed by the President, by and with the advice and consent of the Senate, and they were to serve until the completion of the canal unless sooner removed by the President; and the President was to name one of them as chairman of the commission. It was the purpose of the lawmakers to secure commissioners of engineering skill, but it was not deemed advisable that all of them should be versed in

the science of engineering. It was provided that four, or a majority of the members of the commission, should be engineers, one of them an officer of the army and another an officer of the navy, said officers respectively being upon either the active or the retired list of the army or the navy. And they were to receive such compensation as the President should prescribe, subject to the action of Congress. In addition to the members of the Isthmian Canal Commission, the President was authorized, through the commission, to engage the services of engineers of the army or engineers in civil life, or any other persons necessary for the proper and expeditious prosecution of the work. The President was given complete control over the commission, which was to report to the President, who was to transmit all reports to Congress. In addition the commission was to give Congress such information as it desired at any time. Thus the executive was put in complete control of work upon the canal, while Congress reserved to itself the right to be informed upon any pertinent matter should questions at any time arise as to the proper expenditure of the public money.

The eighth, or final section, of the basic act provided that the Secretary of the Treasury should have authority to borrow on the credit of the United States from time to time as the proceeds might be required to defray the expenses authorized by the act, and to issue coupon or registered bonds to the extent of $130,000,000, or so much thereof as might be necessary. These bonds, some of which have been sold, as work upon the canal has progressed, were to be issued at the rate of two per cent. per annum, redeemable after ten years from the date of issue, and payable thirty years from that date. The bonds were to be disposed of by the Secretary of the Treasury at not less than par, and all citizens of the United States were to have an equal right to subscribe thereto.

The passage of this act, which put the President in a position to begin business, was followed by negotiations that resulted successfully so far as the French interests were concerned, but which did not terminate favorably with respect to Colombia. The Colombian government was slow at coming to a bargain, and before a conclusion was reached, negotiations were completely upset by the revolution of Panama, which declared itself free of Colombian domination. The Republic of Panama, having thus attained its independence and having come to be recognized by the United States, the Hay-Bunau-Varilla treaty of February 26, 1904, was effected. This treaty not only guaranteed the independence of the Republic of Panama, but provided for the payment to Panama of $10,000,000 in gold coin, and an annual payment beginning thereafter, of $250,000, to continue so long as the convention lasted. In consideration of this payment the Republic of Panama, amongst other things, granted to the United States

"all rights which it now has or hereafter may acquire to the property of the New Panama Canal Company and the Panama Railroad Company as a result of the transfer of sovereignty from the Republic of Colombia to the Republic of Panama over the Isthmus of Panama, and authorizes the New Panama Canal Company to sell and transfer to the United States its rights, privileges, properties and concessions as well as the Panama Railroad and all the shares or part of the shares of that company; but the public lands situated outside of the zone described in Article II of this treaty now included in the concessions to both said enterprises and not required in the construction or operation of the canal shall revert to the Republic of Panama, except any property now owned by or in the possession of said companies within Panama or Colon or the ports or terminals thereof."

With the rights and title thus established by the treaty-making power, Congress proceeded in orderly fashion to further the work. On April 28th, 1904, an act was approved to "provide for the temporary government of the Canal Zone at Panama, the protection of the canal works, and for other purposes." This act authorized the President, on the acquisition of the New Panama Canal Company property and the payment of the $10,000,000 to Panama,

"to take possession of and occupy on behalf of the United States the zone of land and land under

water of the width of ten miles, extending to the distance of five miles on each side of the center line of the route of the canal to be constructed thereon, which said zone begins in the Caribbean Sea three marine miles from mean low-water mark and extends to and across the Isthmus of Panama into the Pacific Ocean to the distance of three marine miles from mean low-water mark, and also of all islands within said zone, and in addition thereto the group of islands in the Bay of Panama named Perico, Naos, Culebra, and Flamenco, and, from time to time, of any lands and waters outside of said zone which may be necessary and convenient for the construction, maintenance, operation, sanitation, and protection of the said canal, or of any auxiliary canals or other works necessary and convenient for the construction, maintenance, operation, sanitation, and protection of said enterprise, the use, occupation, and control whereof were granted to the United States by article two of said treaty."

The zone referred to was to be known as "the Canal Zone," and all the military, civil and judicial powers, essential to its temporary government were to be exercised as the President should direct. The inhabitants of the zone were to have "free enjoyment of their liberty, property, and religion." It is noteworthy that this act of April 28, 1904, enlarged upon the Spooner Act, in that in accordance with the Hay-Varilla treaty, it extended the width of the zone from three miles to five miles from the center, thus establishing a zone from sea to sea ten miles in width, instead of six miles as provided for in the organic law. This was much superior to the concessions contemplated in the Colombian negotiations.

From this time on, canal legislation had to do very largely with appropriations to forward the work, and in this respect Congress was ever ready to deal liberally with the estimates of the engineers as they came up through the commission and the President. It was equally helpful during the earlier stages of the work, when Civil Engineers Wallace, Shonts, and Stevens were in control, as it was after the army engineers took charge under the direction of Colonel George W. Goethals. These laws were chiefly in aid of the men who were upon the ground, and for the control of such business as was incident to the occupation of the territory. In February, 1905, it was provided that the Isthmian Canal Commission accounts should be audited by the auditor of the war department. In March of the same year, an act was passed which made the laws of the United States affecting imports and the entry of persons into the United States applicable to merchandise and persons coming from the Canal Zone. That is to say, the tariff laws and the immigration laws were made to treat the zone as foreign territory. The issue of bonds to raise funds to continue the construction was provided for in an act passed in December, 1905. In June, 1906, a joint resolution was passed providing that materials and equipment for use in the construction of the canal would be restricted to articles of domestic production, except in certain cases.

Then, on June 29, 1906, came the very important act which was passed only after a nation-wide discussion, providing for a lock canal, rather than the sea-level canal for which a large body of citizens contended. The lock canal was to be of the "general type proposed by the minority of the board of consulting engineers, created by the order of the President." In this instance the technique of the engineer gave way to the common belief of the legislators that a sea-level canal would be prohibitive as to cost, and more troublesome to control than a lock canal. The lock-canal system, which is now in operation, received its sanction through this act, and the locks and dams, as now completed, are the product of the nearly nine years' labor ensuing.

From 1906 on, the legislation related chiefly to appropriations and supervision of canal work, railroad construction, and the like, and was attached to the annual Sundry Civil and Urgent Deficiency bills. In May, 1908, it was deemed proper to provide compensation for injuries sustained by employees in the course of their employment on the Canal Zone, and several measures with this end in view were enacted. Leases of land to tenant holders, some of them desiring to conduct small



1. Looking south past Cucaracha slide, December 9, 1913.
2. Nine days later, looking north.



1. How Cucaracha slide came down many times a year and bottled up the south end of Culebra Cut.
2. Laborers trying to lead a stream of Gatun Lake water through the slide and down to Pedro Miguel.

plantations, were provided for in February, 1909, but these leases have since been revoked, owing to the determination of the government to clear the zone of all occupants save those employed in the control or supervision of the property. Numerous other appropriation and regulatory acts were passed down to 1911, when provision was made for sea-coast batteries and for construction work looking to the fortification of the Canal Zone.

The time had come, in the judgment of Congress, to provide for the protection of the canal, and this was done, notwithstanding a wide-spread agitation in favor of neutralization. The friends of neutralization in Congress contended that it would be far better to have the nations that expected to use the canal coöperate with the United States on friendly terms, rather than to establish fortifications which might be regarded as a challenge; but the military experts prevailed and the fortifications were set up, it being contended that the right to do so was fully supported by the Hay-Pauncefote treaty.

When eventually the work had so far advanced that Colonel Goethals and his associates advised the President that the opening of the canal might be expected along about July 1, 1915, the President, who at that time was Mr. Taft, suggested to Congress the propriety of preparing for the actual work of operation and government. The act, "to provide for the opening, maintenance, protection, and operation of the Panama Canal, and the sanitation and government of the Canal Zone," approved August 24, 1912, was the result. This act, considered and passed by a Democratic Congress, and approved by a Republican President, who had formerly been Secretary of War, naturally evoked much discussion. It was argued at great length in Senate and House, the discussion centering largely upon the question of tolls,—a question which was destined to become an issue in the succeeding political campaign.

The canal was opened nearly a year ahead of the predictions of the engineers, not formally, but sufficient for the passage of small boats connected with the work, and ultimately for regular vessels of commerce, from which, up to about the 1st of February, 1915, tonnage tolls were collected to the extent of about $2,000,000.

While the act approved by President Taft, August 24, 1912, embodied many preceding provisions of law with respect to the operation of the canal, it also contained a number of new provisions, some of them made necessary by the actual operation and maintenance of the property as a canal. Being the law under which, in the main, the government of the Canal Zone is now conducted, reference should be made to some of its provisions. The first section defines the Canal Zone and distinguishes the canal by title as "The Panama Canal." It authorizes the President, by treaty with the Republic of Panama, to acquire any land above or under the water that may be desired in addition to the ten-mile strip. Section 2 gives validity to all laws, orders, regulations and ordinances heretofore adopted and promulgated in the Canal Zone by order of the President, and continues the courts, subject in each instance to the direction of Congress.

Sections 3 and 4 authorize the President by executive order to dispose of all private titles or claims to land on the Canal Zone under certain conditions, and to dispense with the services of the Isthmian Canal Commission when in his judgment it may seem proper. Upon the discontinuance of the Isthmian Canal Commission, the President was authorized to complete, govern, and operate the canal and the Canal Zone, or to direct that it be done,

> "through a governor of the Panama Canal and such other persons as he may deem competent to discharge the various duties connected with the completion, care, maintenance, sanitation, operation, government, and protection of the Canal and Canal Zone.

The President, acting upon this authority, made Colonel Goethals governor of the canal, and he is now in charge. These details respecting appointments, compen-

sation and so forth, are taken from section 4:

"If any of the persons appointed or employed as aforesaid shall be persons in the military or naval service of the United States, the amount of the official salary paid to any such person shall be deducted from the amount of salary or compensation provided by or which shall be fixed under the terms of this Act. The governor of the Panama Canal shall be appointed by the President, by and with the advice and consent of the Senate, commissioned for a term of four years, and until his successor shall be appointed and qualified. He shall receive a salary of ten thousand dollars a year. All other persons necessary for the completion, care, management, maintenance, sanitation, government, operation, and protection of the Panama Canal and Canal Zone shall be appointed by the President, or by his authority, removable at his pleasure, and the compensation of such persons shall be fixed by the President, or by his authority, until such time as Congress may by law regulate the same, but salaries or compensation fixed hereunder by the President shall in no instance exceed by more than twenty-five per centum the salary or compensation paid for the same or similar services to persons employed by the government in continental United States. That upon the completion of the Panama Canal the President shall cause the same to be officially and formally opened for use and operation."

The formal opening of the canal as provided for in this section, attaches to the administration of President Wilson, but owing to foreign war conditions and other considerations, action was deferred, although the canal was open for business.

That Congress had in mind the symmetry of canal construction, as well as the engineering side of it, is shown by a footnote to section 4, which provides that the Commission of Fine Arts may make report to the President regarding the artistic character of the structures of the canal, evidently referring to locks, office buildings, lighthouses, and other structures. Recommendations on this line were to be transmitted to Congress.

The tolls question was provided for in section 5, and this section, by the way, soon proved to be the most important in the bill. First the President was authorized

"to prescribe and from time to time change the tolls that shall be levied by the Government of the United States for the use of the Panama Canal: *Provided*, That no tolls, when prescribed as above, shall be changed, unless six months' notice thereof shall have been given by the President by proclamation. No tolls shall be levied upon vessels engaged in the coastwise trade of the United States."

The tolls question at once became the great bone of contention in Congress and outside. During the latter part of President Taft's term, and by reason of a plank in the Democratic platform, declaring for free passage of American ships using the canal, it continued to be a source of annoyance to President Wilson, who, shortly after he entered the White House, insisted upon the repeal of the "free tolls" clause. He demanded of Congress the passage of a bill requiring the vessels of all nations, including our own, to pay tolls on equal terms with all other nations, in accordance with the contention of those who insisted that we were obligated, by the Hay-Pauncefote treaty, to treat ourselves in the matter of tolls exactly as we would treat the other nations. In due course, as will be shown hereafter, the exemption clause of the act of August 24, 1912, was repealed.

The tolls clause, however, was not the only important feature of section 5 of the act just referred to. That section so amended the Revised Statutes of the United States as to have section 4132 read as follows:

"Sec. 4132. Vessels built within the United States and belonging wholly to citizens thereof; and vessels which may be captured in war by citizens of the United States and lawfully condemned as prize, or which may be adjudged to be forfeited for a breach of the laws of the United States; and seagoing vessels, whether steam or sail, which have been certified by the Steamboat-Inspection Service as safe to carry dry and perishable cargo, not more than five years old at the time they apply for registry, wherever built, which are to engage only in trade with foreign countries or with the Philippine Islands and the islands of Guam and Tutuila, being wholly owned by citizens of the United States or corporations organized and chartered under the laws of the United States or of any State thereof, the president and managing directors of which shall be citizens of the United States or corporations organized and chartered under the laws of the United States or of any State thereof, the president and managing directors of which shall be citizens of the United States, and no others, may be registered as directed in this title. Foreign-built vessels registered pursuant to this Act shall not engage in the coastwise trade: *Provided*, That a foreign-built yacht, pleasure boat, or vessel not used or intended

to be used for trade admitted to American registry pursuant to this section shall not be exempt from the collection of ad valorem duty provided in section thirty-seven of the Act approved August fifth, nineteen hundred and nine, entitled 'An Act to provide revenue, equalize duties, and encourage the industries of the United States, and for other purposes.' That all materials of foreign production which may be necessary for the construction or repair of vessels built in the United States and all such materials necessary for the building or repair of their machinery and all articles necessary for their outfit and equipment may be imported into the United States free of duty under such regulations as the Secretary of the Treasury may prescribe: *Provided further*, That such vessels so admitted under the provisions of this section may contract with the Postmaster-General under the Act of March third, eighteen hundred and ninety-one, entitled 'An Act to provide for ocean mail service between the United States and foreign ports, and to promote commerce,' so long as such vessels shall in all respects comply with the provisions and requirements of said Act."

It will be observed that this paragraph made some very radical changes in existing law apart from canal construction, entering as it does into the registration of seagoing vessels and touching also upon the tariff and ship subsidies. With reference to tolls, section 5 provided that

"Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise, and may be based on one form of tonnage for warships and another for ships of commerce. The rate of tolls may be lower upon vessels in ballast than upon vessels carrying passengers or cargo. When based upon net registered tonnage for ships of commerce the tolls shall not exceed one dollar and twenty-five cents per net registered ton, nor be less, other than for vessels of the United States and its citizens, than the estimated proportionate cost of the actual maintenance and operation of the canal, subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three. If the tolls shall not be based upon net registered tonnage, they shall not exceed the equivalent of one dollar and twenty-five cents per net registered ton as nearly as the same may be determined, nor be less than the equivalent of seventy-five cents per net registered ton. The toll for each passenger shall not be more than one dollar and fifty cents."

The President was authorized to make regulations governing the operation of the canal and the passage and control of vessels. These regulations were to include the adjustment of damages for injury to vessels, cargo, or passengers, and a method for determining and adjusting claims arising from personal injuries to employees on the canal or the Panama Railroad. In addition, in Section 6, the President was authorized to erect and maintain radio-communication, or wireless telegraph stations, messages of the government of the United States, or departments thereof, to have precedence over all other messages. The same section provided for the erection of drydocks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances for providing coal and other materials, labor, repairs, and supplies for vessels of the government of the United States, and incidentally for supplying such commodities to passing vessels at reasonable prices. In this, Congress desired to facilitate the transit of vessels of other nations as well as of those of the United States.

The Governor of the Panama Canal was given power, in section 7, to perform all duties in connection with the civil government of the Canal Zone. He was to perform all such executive and administrative duties as might be required by existing law. This section provided also for the location of towns on the Canal Zone, and for the trial of civil and criminal cases in the minor courts. Courts of higher jurisdiction were provided for in sections 8 and 9, and section 10 conferred upon the governor, with the approval of the President, certain powers determining "the right of any person to remain upon or pass over any part of the Canal Zone." This provision was in accordance with the idea that residence on the Canal Zone, for sanitary as well as precautionary reasons, and to promote good order, should be limited to those actually engaged in work upon the canal, and their families.

Section 11 of the law is of so important a nature, as it relates to powers conferred upon the Interstate Commerce Commission, that it is inserted here in full. The exclusion of railroad-owned ships from the right to use the canal, and various other

serious questions involving transportation rates, both by rail and by water, have since been under consideration by the Interstate Commerce Commission, much to the concern of shippers as well as of railroads owning ships and others that do not. The section referred to is as follows:

"Sec. 11. That section five of the Act to regulate commerce, approved February fourth, eighteen hundred and eighty-seven, as heretofore amended, is hereby amended by adding thereto a new paragraph at the end thereof, as follows:

"'From and after the first day of July, nineteen hundred and fourteen, it shall be unlawful for any railroad company or other common carrier subject to the Act to regulate commerce to own, lease, operate, control, or have any interest whatsoever (by stock ownership or otherwise, either directly, indirectly, through any holding company, or by stockholders or directors in common, or in any other manner) in any common carrier by water operated through the Panama Canal or elsewhere with which said railroad or other carrier aforesaid does or may compete for traffic or any vessel carrying freight or passengers upon said water route or elsewhere with which said railroad or other carrier aforesaid does or may compete for traffic; and in case of the violation of this provision each day in which such violation continues shall be deemed a separate offense.'

"Jurisdiction is hereby conferred on the Interstate Commerce Commission to determine questions of fact as to the competition or possibility of competition, after full hearing, on the application of any railroad company or other carrier. Such application may be filed for the purpose of determining whether any existing service is in violation of this section and pray for an order permitting the continuance of any vessel or vessels already in operation, or for the purpose of asking an order to install new service not in conflict with the provisions of this paragraph. The commission may on its own motion or the application of any shipper institute proceedings to inquire into the operation of any vessel in use by any railroad or other carrier which has not applied to the commission and had the question of competition or the possibility of competition determined as herein provided. In all such cases the order of said commission shall be final.

"If the Interstate Commerce Commission shall be of the opinion that any such existing specified service by water other than through the Panama Canal is being operated in the interest of the public and is of advantage to the convenience and commerce of the people, and that such extension will neither exclude, prevent, nor reduce competition on the route by water under consideration, the Interstate Commerce Commission may, by order, extend the time during which such service by water may continue to be operated beyond July first, nineteen hundred and fourteen. In every case of such extension the rates, schedules, and practices of such water carrier shall be filed with the Interstate Commerce Commission and shall be subject to the Act to regulate commerce and all amendments thereto in the same manner and to the same extent as is the railroad or other common carrier controlling such water carrier or interested in any manner in its operation: *Provided*, Any application for extension under the terms of this provision filed with the Interstate Commerce Commission prior to July first, nineteen hundred and fourteen, but for any reason not heard and disposed of before said date, may be considered and granted thereafter.

"No vessel permitted to engage in the coastwise or foreign trade of the United States shall be permitted to enter or pass through said canal if such ship is owned, chartered, operated, or controlled by any person or company which is doing business in violation of the provisions of the Act of Congress approved July second, eighteen hundred and ninety, entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," or the provisions of sections seventy-three to seventy-seven, both inclusive, of an Act approved August twenty-seventh, eighteen hundred and ninety-four, entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purposes," or the provisions of any other Act of Congress amending or supplementing the said Act of July second, eighteen hundred and ninety, commonly known as the Sherman Antitrust Act, and amendments thereto, or said sections of the Act of August twenty-seventh, eighteen hundred and ninety-four. The question of fact may be determined by the judgment of any court of the United States of competent jurisdiction in any cause pending before it to which the owners or operators of such ship are parties. Suit may be brought by any shipper or by the Attorney General of the United States.

"That section six of said Act to regulate commerce, as heretofore amended, is hereby amended by adding a new paragraph at the end thereof, as follows:

"'When property may be or is transported from point to point in the United States by rail and water through the Panama Canal or otherwise, the transportation being by a common carrier or carriers, and not entirely within the limits of a single State, the Interstate Commerce Commission shall have jurisdiction of such transportation and of the carriers, both by rail and by water, which may or do engage in the same, in the following particulars, in addition to the jurisdiction given by the Act to regulate commerce, as amended June eighteenth, nineteen hundred and ten:

"'(a)To establish physical connection between the lines of the rail carrier and the dock of the water carrier by directing the rail carrier to make suitable connection between its line and a track or tracks which have been constructed from the dock to the limits of its right of way, or by directing either or both the rail and water carrier, individually or in connection with one another, to construct and connect with the lines of the rail carrier a spur track or tracks to the dock. This provision shall only apply where such connection is reasonably practicable, can be made with safety to the public, and where the amount of business to be handled is sufficient to justify the outlay.

"'The commission shall have full authority to determine the terms and conditions upon which these connecting tracks, when constructed, shall be operated, and it may, either in the construction or the operation of such tracks, determine what sum shall be paid to or by either carrier. The provisions of this paragraph shall extend to cases where the dock is owned by other parties than the carrier involved.

"'(b) To establish through routes and maximum joint rates between and over such rail and water lines, and to determine all the terms and conditions under which such lines shall be operated in the handling of the traffic embraced.

"'(c) To establish maximum proportional rates by rail to and from the ports to which the traffic is brought, or from which it is taken by the water carrier, and to determine to what traffic and in connection with what vessels and upon what terms and conditions such rates shall apply. By proportional rates are meant those which differ from the corresponding local rates to and from the port and which apply only to traffic which has been brought to the port or is carried from the port by a common carrier by water.

"'(d) If any rail carrier subject to the Act to regulate commerce enters into arrangements with any water carrier operating from a port in the United States to a foreign country, through the Panama Canal or otherwise, for the handling of through business between interior points of the United States and such foreign country, the Interstate Commission may require such railway to enter into similar arrangements with any or all other lines of steamships operating from said port to the same foreign country.'

"The orders of the Interstate Commerce Commission relating to this section shall only be made upon formal complaint or in proceedings instituted by the commission of its own motion and after full hearing. The orders provided for in the two amendments to the Act to regulate commerce enacted in this section shall be served in the same manner and enforced by the same penalties and proceedings as are the orders of the commission made under the provisions of section fifteen of the Act to regulate commerce, as amended June eighteenth, nineteen hundred and ten, and they may be conditioned for the payment of any sum or the giving of security for the payment of any sum or the discharge of any obligation which may be required by the terms of said order."

Having thus imposed upon the Interstate Commerce Commission a very great responsibility in the matter of rates in connection with the operation and maintenance of the canal, Congress provided in the other sections of the governing act for the extradition of persons accused of crime (section 12) and for placing exclusive authority and jurisdiction over the canal and all its adjuncts upon such officer of the army as the President might designate should war, or the imminence of war, make such designation and such army control expedient. The last section of the act provided, for the sake of convenience and to distinguish it from the Spooner Act and all others, that it should be known as "The Panama Canal Act."

This, in brief, is the story of the law governing the Panama Canal. It remains but to consider one or two other measures apart from appropriation bills that have an important bearing upon the entire canal subject. The repeal act of June 15, 1914, was one of these. The discussion over the repeal of the tolls exemption clause was one of the most exciting of the Sixty-third congress. Democrats and Republicans divided upon the question, but most of the former supported the repeal bill because of the attitude of President Wilson. Distinguished leaders like Speaker Clark and Mr. Underwood opposed the President in the House, while Senator O'Gorman, of New York, and others in the Senate fought earnestly for freedom from tolls. Senator Root made one of the most remarkable speeches of his career in the Senate, insisting that the United States was morally bound to repeal the free tolls exemption provision of the Panama Canal Act. In both houses, treaty provisions and diplomatic correspondence were raked over with a fine-tooth comb. All previous laws that had any bearing upon the subject were dragged into the discussion. The Republican leader of the House, Mr. James R. Mann, of Illinois, who had gone on the Committee on Interstate and Foreign Commerce when he entered the House in the Fifty-fifth congress, argued against the repeal and in favor of the right of the United States to grant preferential tolls or no tolls at all to the American merchant marine. The Democratic chairman of the Committee on Interstate and Foreign Commerce, Mr. Adamson, of Georgia, who had been a member of the committee since the days of Colonel Hepburn, and who first debated the tolls question with that distinguished Iowan, took issue with both the

Republican leader and the Democratic leader of the House, insisting that there was no excuse for releasing American ships from the tolls imposed upon ships of other nations.

In reporting the repeal bill for the majority of his committee, Mr. Adamson said:

"During the last Congress your committee recommended uniform tolls. By an amendment vessels engaged in the coastwise trade of the United States were exempted and discretion was left in the President when levying tolls, based on net registered tonnage, on vessels of commerce of the United States and its citizens to fix them lower than on other vessels of commerce. The amendment also made possible a discrimination by fixing the minimum tolls on other vessels, based on net registered tonnage, at the cost of operation, while in levying tolls based on other forms of tonnage the minimum was fixed at the equivalent of 75 cents per net registered ton. The purpose of this bill is to repeal the exemption of vessels engaged in coastwise trade and to amend the other language so as to remove the possibility of discrimination in order to promote equality at the canal."

For a minority of the committee, although all of the minority were not of one mind, Mr. Knowland, of California, presented an earnest report against what he termed "The humiliating surrender of every American right at Panama." Said Mr. Knowland:

"I emphatically dissent from the views of the majority which are in the main but a reiteration of the arguments advanced by Sir Edward Grey, secretary of state for foreign affairs of Great Britain, in opposition to the position taken by Congress when it enacted the existing canal law, which American position was strongly upheld by Secretary of State Knox on behalf of this Government.

"I vigorously protest against the attempt to force the Congress of the United States, through a legislative enactment, to give a British interpretation to the Hay-Pauncefote treaty, thus surrendering for all future time rights vitally affecting this nation commercially, strategically, and politically.

"A situation unparalleled and unprecedented in history now confronts this country. The custodian of our rights, our agent in dealing with foreign affairs, advocates the case of Great Britain. We are left without a spokesman. With no attempt to settle through diplomatic channels, with no suggestion looking to the reference of the vital question to arbitration, unconditional and complete surrender is urged."

In spite of the most determined opposition in Senate and House the repeal bill was finally passed. The President approved it June 15, 1914. This act, which reversed the tolls exemption provision of the Panama Canal Act, and set at naught the tolls plank of the Democratic platform at Baltimore, is now the law. It contains the proviso, "reserving all rights," which was tacked on to it in the Senate, and which served to ease the minds of certain Senators on the mooted question of British domination over our affairs. The insertion of this proviso facilitated the passage of the bill when its life in the Senate was threatened. Divested of its title, the repeal act is as follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the second sentence in section five of the Act entitled 'An Act to provide for the opening, maintenance, protection, and operation of the Panama Canal, and the sanitation and government of the Canal Zone,' approved August 24, 1912, which reads as follows: 'No tolls shall be levied upon vessels engaged in the coastwise trade of the United States,' be, and the same is hereby, repealed.

"Sec. 2. That the third sentence of the third paragraph of said section of said Act be so amended as to read as follows: 'When based upon net registered tonnage for ships of commerce the tolls shall not exceed $1.25 per net registered ton, nor be less than 75 cents per net registered ton, subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three': *Provided,* That the passage of this Act shall not be construed or held as a waiver or relinquishment of any right the United States may have under the treaty with Great Britain, ratified the 21st of February, 1902, or the treaty with the Republic of Panama, ratified February 26, 1904, or otherwise, to discriminate in favor of its vessels by exempting the vessels of the United States or its citizens from the payment of tolls for passage through said canal, or as in any way waiving, impairing, or affecting any right of the United States under said treaties, or otherwise, with respect to the sovereignty over or the ownership, control, and management of said canal and the regulation of the conditions or charges of traffic through the same."

Another very important change in the Panama Canal Act of August, 1912, was the repeal on August 18, 1914, of that provision of the governing act which undertook to protect American ships against the registration of foreign-built ships "not more than five years old at the time they apply for registry, wherever built." In pursuance of a shipping policy inaugu-

rated by the administration and involving the purchase of foreign ships, it was sought to waive the limitation of five years, and so the Committee on Merchant Marine and Fisheries, Mr. Alexander, of Missouri, chairman, brought in the bill which Congress adopted. This measure, which is appended, gives a wide latitude to the President in authorizing the registry of ships and in suspending laws that have hitherto been regarded as protecting American interests with respect to ships and seamen. Under this act, President Wilson promptly prepared an order suspending the navigation laws in the manner set forth:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the words 'not more than five years old at the time they apply for registry' in section five of the Act entitled 'An Act to provide for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone,' are hereby repealed.

"Sec. 2. That the President of the United States is hereby authorized, whenever in his discretion the needs of foreign commerce may require, to suspend by order, so far and for such length of time as he may deem desirable, the provisions of law prescribing that all the watch officers of vessels of the United States registered for foreign trade shall be citizens of the United States.

"Under like conditions, in like manner, and to like extent the President of the United States is also hereby authorized to suspend the provisions of the law requiring survey, inspection, and measurement by officers of the United States of foreign-built vessels admitted to American registry under this Act.

"Sec. 3. This Act shall take effect immediately."

Since the passage of this act and the issuance of regulations by the President in conformity thereto, there was no legislation of consequence to the canal down to March, 1915, save as to appropriations for operation and maintenance. While the formal opening, in which the President was expected to participate, was deferred for prudent reasons, vessels of the United States and of all nations were using the canal, and the long-looked-for union of the two oceans was effected. Some of the vessels carried passengers from the Atlantic Coast to the Panama-Pacific Exposition at San Francisco, and cargoes of valuable merchandise were carried through the canal from coast to coast. The effect upon the trans-continental railroads was perceptible, and the Interstate Commerce Commission was soon called upon to exercise some of its powers conferred by the Panama Canal Act with respect to railroad-owned vessels and freight rate adjustments.

In concluding this sketch of Panama Canal legislation, it may be appropriate now, as it was on June 20, 1912, when the question of canal fortifications was under consideration in the House of Representatives, to put the question as the writer then did: "The Panama Canal: Why Did We Build It—For Commerce or War?" At that time the thought in mind was that commerce and agriculture should be encouraged on the Canal Zone; that those who went to the Zone should aid in the promotion of business and thus assist the United States in obtaining a fair return for its vast expenditure. It was argued also that the encouragement of agriculture would aid in meeting the problems of the food supply on the Isthmus. Amendments proposing a study of the commercial opportunities afforded by the canal, as well as the agricultural possibilities of the land above water, were offered, but the military idea was then in the ascendant, and it was deemed best to clear the zone of all inhabitants except in Panama City, Colon, and other designated settlements. The amendments were therefore rejected. It is to be presumed, however, that in due course, as the government work upon the canal increases, and as international shipping avails itself more generally of the advantages of the canal, problems of fuel and food supply, along with the many other problems incident to so great an undertaking, will result in some action by the United States to secure for its merchants and business men such advantages in South America and the international trade as the ownership and operation of the canal would seem to justify. Otherwise the value of the canal as a stimulant to trade and a promoter of American interests will not be fully realized.

CHAPTER XL

PROBLEMS OF QUARANTINE

THE GEOGRAPHY OF DISEASE—OPENING OF CANAL PROVIDES HIGHWAY FOR DISEASES AS WELL AS FOR COMMERCE—BUBONIC PLAGUE, CHOLERA, YELLOW FEVER, LEPROSY, TYPHUS, AND SMALLPOX ANCIENT WANDERERS THAT FOLLOW MANKIND AROUND THE EARTH—PRECAUTIONS TO BE TAKEN AT PANAMA—SANITARY EFFECT UPON COMMERCE OF THE NEW TRADE ROUTE—UNITED STATES GOVERNMENT ACQUIRES JURISDICTION OVER FOREIGN VESSELS FOR QUARANTINE PURPOSES.

BY RUPERT BLUE, M.D., D.P.H.

Surgeon-General, United States Public Health Service.

THE first problems in the Panama Canal project were sanitary ones incidental to its construction. With the opening of the canal to commerce other problems equally grave and demanding sanitary acumen of the highest order will present themselves. Difficulties must be expected and forestalled wherever nature is to be dominated and made to serve man's purposes. Such has been the invariable experience from the earliest history of humanity's struggling progress. All the difficulties were not passed when primitive man lassoed the first wild horse, taught it to feed in the stall and fixed the bit in its refractory mouth—there still remained the perils of horsemanship. The construction and launching of the first rude canoe was a notable victory over the watery bounds hemming in the savage's activity, but shipwreck and the perils of the sea were yet to be contended with and a thousand expedients for as many difficulties invented. The aeroplane mounts to the clouds, but the daily press is an endless chronicle of the dangers of the navigation of the air. The ventilating of tunnels, the fireproofing of buildings, safety appliances in railroad transportation are other examples of the continued efforts in the interest of human welfare called for after the successful installation of useful improvements on older ways of doing things.

The high standard of sanitation already established in the Canal Zone must be maintained as long as the canal is to be operated with safety to health. In addition to this continuance of sound hygienic practices already begun, new problems will immediately arise with the opening of the canal—problems incidental to the changes in the routes of navigation, highways, not only of commerce, but of epidemic disease.

No branch of geography is more subject to changes than the geography of disease as the result of great human movements such as those caused by war, by emigration, by the opening of new territory, or by changes in the routes of commerce on land and sea. This is particularly the case with the geographic distribution of quarantinable diseases. It is usual to speak of these diseases as having endemic areas in certain parts of the world, centers in which they have become established and from which, under favoring conditions, they issue and spread to sections previously unoccupied by them, sometimes forming new centers of permanent prevalence.

In order to comprehend this matter clearly, it must be remembered that epidemic disease is but a manifestation of an existing cause, the living germ whose presence in the human body excites the phenomenon we call disease. The geography of disease resolves itself then into the



1. Early print of the present city of Panama.
2. Ancon Hospital grounds, with Tivoli Hotel in the distance.

distribution of the disease-producing factors, and is precisely analogous to the distribution of groups of plants or animals. The habitat of all plants and animals is subject to mutations due to many familiar causes, as, for example, geological and climatic changes and the invasion of new territory by other animals or by man. The appearance, disappearance or re-appearance of any given disease in a special territory is very similar to the behavior of insects and plants under certain conditions. Changes of an effective nature likely to operate on the geographical distribution of diseases caused by living organisms are to be expected as a result of the modifications in world routes incidental to the opening of the Panama Canal.

It is self-evident that diseases whose distribution varies widely at different times and under changing circumstances are those against which the measures included in the practice of quarantine apply. Plague is a scourge whose wanderings in many ages over the face of the earth have linked its dismal story with the history of mankind in many epochs. Cholera is another traveler whose fatal shadow has been thrown over many a melancholy chronicle in the pages of history. Yellow fever, issuing from its tropical home, has too often followed the routes of travel and commerce. Leprosy, an ancient wanderer; typhus, haunting the abodes of poverty and filth; and smallpox, a squatter in various climes, are other ills whose vagrancy have caused them to be classified among quarantinable diseases.

Research in recent years, by the application of modern laboratory methods, has led to very precise knowledge of the causative agents of infectious diseases. In no branch of medicine have these scientific advances been productive of greater benefit than in the combat with the disease scourges accompanying civilization in its commercial, emigratory and colonizing movements. The story of these ills tracking mankind on a thousand marches and voyages is of intense economic interest.

The close connection between new routes of travel and the spread of disease is shown by the fact that the word "Lazaretto" was brought back by the crusaders on their return to Europe. Places outside the gates of nearly all the principal cities of Europe were built for the reception of sick crusaders, who also brought back with them numerous diseases. The name came from that of the Hospital of St. Lazarus, a place of sequestration for contagious maladies which the crusaders erected outside the walls of Jerusalem after taking the city from the Mussulmans. Leprosy became widespread during the epoch of the crusades as the result of opening new routes of travel and increased use of old routes.

Plague is a disease which has always maintained itself in certain endemic centers in Asia from which waves of diffusion, following lines of travel, have from time to time originated. New foci have been temporarily formed in different parts of the world, and from these secondary centers epidemic waves have spread. The relation between the prevalence of plague among rodents and its outbreak in men is notably emphasized in the chronicles of the disease, the infection being generally conveyed from rat to rat and from rat to man through the agency of fleas. The expediency of ridding ships from rats is obvious.

Cholera, a disease having its home in India, particularly about the delta of the Ganges, has followed almost invariably in its excursions throughout the world the lines of traffic by land and water, selecting certain routes and omitting others. The most important of recent discoveries regarding this disease is that persons exhibiting no symptoms of illness may carry the disease in their bodies and communicate it to others. The necessity for a rigid laboratory examination of all exposed persons is evident. Yellow fever has long been associated with the shipping. The prevention of its spread from port to port by screening and mosquito destruction has been made possible by the demonstration of

the connection of a species of mosquito insect with the disease.

Every good, it is said, brings evils in its train. The shortening of certain ocean routes by the opening of the Panama Canal means in many cases the bringing closer together of disease centers with territory whose invasion by such disease is feared. This disadvantage may be neutralized by the proper application of sanitary measures. Geographical disadvantages, obstacles in themselves to traffic, are often barriers against the spread of disease. Their removal, effected by the intelligence and energy of man, must go hand in hand with artificial defenses against the passage of disease. An interesting point of inquiry is to what extent freedom from imported disease is due to geographical position and climatic conditions. The peculiar geographical position of Great Britain minimizes to a certain degree the introduction of disease through commerce. The application of sanitary measures to the specific cases arising from the great changes in ocean routes is the problem whose successful solution, by methods at present available, is the task presenting itself to the sanitarian with the opening of the Panama Canal. The difficulties of the work can be to a large extent foreseen and hence provided for, but it is natural to expect that special conditions, wholly novel concerning details, will arise calling for solution on the spot and perhaps giving origin to improved procedures beneficial to public health. Often in this way disadvantages are turned into advantages and the efforts to correct matters in single instances result in widespread improvement in lines not directly parallel with those in point. As a concrete example, the measures at Panama against rats as carriers of plague may lead to the fulfillment of a hope long entertained of rendering rat-free the shipping of the world.

Because of its close commercial relations with foreign ports, this country is deeply interested in the health of other countries. Great strides in the direction of world sanitation can be made by the policy of demanding that all vessels passing through the canal, even when the port of departure and that of destination are foreign ports, shall be in the health condition required by the United States quarantine regulations for vessels arriving at domestic ports. This means that no vessel issuing from the canal shall have on board any person sick of quarantinable disease, or shall lodge any human carrier of such disease, or any animal, such as rats or mosquitoes, capable of conveying disease. Loss of time in the operation of quarantine measures, fumigation and the like, may in appropriate cases be obviated by their application during the transit of the vessels through the canal. By such courses, sanitation, which made the cutting of the canal possible, may bestow a further boon on the world by making the canal a sieve to sift out disease dangers that might otherwise pass through the world's highways, infecting other lands and perhaps in time returning to our shores.

The high seas are a road to which no nation claims ownership. Its routes are open to all. Each nation imposes such regulations as it deems fit on vessels sailing under its flag. But sanitary restraints foreign to the country where a vessel is registered do not become effective until the vessel enters within the jurisdiction of the foreign government under whose authority the regulations were made. The coming of a vessel within the sphere of control of a nation having an interest in the health of the world is an opportunity of unusual advantage for bringing into action sanitary rules and practices beneficial to shipping, having in mind in the selection of these measures, the minimum restraint of commerce consistent with effectiveness.

It is especially important to improve such a favorable opportunity for the betterment of the hygiene of shipping in view of the fact that, with the rising standard of living, there is in operation a progressive increase in traffic by sea. Not only

are civilized nations becoming yearly more dependent on foreign trade, but even half-savage peoples, from lack of local manufactures, look to shipping as a means of trading the crude products of wild lands for clothing and certain food elements originating in distant parts of the world.

Though unrestrained at sea, the freedom of a ship comes at once, as has been indicated, under control the moment the vessel enters the limits of a port. Not only do regulations become effective controlling air space, light, ventilation and life-saving appliances, but rules are prescribed bearing on the health of passengers and crews and on the presence aboard of living beings, such as rats, the carriers of plague, and mosquitoes, the intermediaries between patients afflicted with yellow fever. Thus governments as public protectors, are under obligation to the people to see that every reasonable effort is made on every available occasion to protect the health of those who go to sea and of those with whom sea-going persons and the vessels that carry them are brought in contact ashore.

Arriving within the limits of a port, the inbound vessel must stop, and submit to inspection of everything aboard, papers, passengers, crew, cargo, supplies, the ship itself, in so far as the quarantine authorities deem expedient. As a result of this examination the vessel is either given free pratique to enter port, or may be detained for the application of such sanitary measures as are deemed necessary in the interest of public health.

A knowledge of the highways of the sea, of the localities where disease is likely to prevail, and of the changes of relations between ports that will be brought about by the opening of the Panama Canal, is necessary to a clear understanding of the questions under consideration. The ocean trade routes of the world, too numerous even to be charted on ordinary maps, could not be intelligibly reviewed within a limited space. They are multitudinous. The use of steam has doubled the number. All routes, because of the complex relations of trade, will be directly, indirectly or remotely affected immediately or at a later period by the opening of the canal. The full extent of the effect of these changes on international health aspects can only be surmised.

In order to understand clearly the extent of changes involved, a glance may with benefit be taken at the chief trade routes of the world without going so far afield, or rather to sea, as to trace the endless side-tracks, feeders and other accessory routes, except when their consideration has direct bearing on quarantine.

The chief routes of the North Atlantic are those connecting the Atlantic Coast of the United States with ports of Northern Europe. One-sixth of the ocean commerce of the world, carried by the largest and fastest vessels, follows this route. Any epidemic disease occurring in ports brought thus into relation may take the same path.

The route created by the Suez Canal is next in importance. It passes from the Atlantic through the Straits of Gibraltar, with accessory routes including all ports of the Mediterranean, and then around the continent of Asia to Japan. Cholera and plague have in Asia their endemic homes near the tributaries of this track, and along its course are many ports opening into territory both in Europe and in Asia that has on numerous occasions received the visitations of these scourges. The epidemic of cholera in Italy and elsewhere in Europe in 1910 and 1911 is an example.

The South African route, drawing on the scattered settlements of the west coast of Africa, divides at the Cape Verde Islands into two branches, one bound for the English Channel, the other for New York. By these routes, the world's highway is open to communicable diseases that may from time to time prevail on the west coast of Africa. Cape Colony, Natal, Rhodesia, and the Transvaal were, within the last decade, the seat of an extended epidemic of plague

The region to the eastward of Cape of Good Hope receives visits from vessels passing along the west coast. Some go to Australia and New Zealand, countries afflicted with plague during the prevalence of the present world-wide epidemic of that disease. This route to Australia is used in preference to the Suez route by vessels plying between the United States and Australia.

Around the coast of South America from the eastern projection of that continent to Panama and up the west coast of North America to British Columbia sweeps another great world highway. Yellow fever, plague, and smallpox are among the unwelcome visitors which vessels visiting certain ports on this route may involuntarily receive aboard. Calls are often made at Rio de Janeiro and Santos, where Brazilian coffee is received, and at the River Plate, where grain and meat are the chief cargoes. Commodities of various character are received and discharged at ports between southern Chile and Guayaquil, a region parts of which, because of their insalubrity, are the subject of much alarm on the part of sanitarians, travelers and the shipping interests. Vessels in the New Zealand trade returning to Europe with cargo add to the shipping through the Strait of Magellan, and certain steamers running between New York and San Francisco or Hawaii pass through the same channel.

The routes entering the Gulf of Mexico and the Caribbean Sea by the several inlets are frequented by vessels from the Atlantic Coast of the United States and from Europe which visit, as do also vessels from the Gulf Coast of the United States, the many ports of that tropical region and are thus exposed to the dangers of yellow fever, plague, and other communicable disease which may at the time exist at these places.

Of Pacific routes, the most important is that connecting North America and Asia. San Francisco, Puget Sound, Portland, and San Diego are the well-known American termini. Manzanillo and Salina Cruz are the Mexican ports interested. Some vessels call at Hawaii, and all courses meet at Yokohama, whence the route follows the coast of Asia, having access to ports closely scrutinized for cholera and plague, and thence to the Philippines.

Finally, there are the routes from the Pacific Coast, whereby San Francisco is connected with New Zealand, via Tahiti; and Vancouver with Australia and the Fiji Islands.

The most decided effect in trade routes incidental to the opening of the Panama Canal will be the change in the route around South America. By way of the canal the voyage from New York to San Francisco will be 5,000 miles, which is 8,000 miles shorter than by the Magellan route. New Orleans will save 9,000 miles and Liverpool 6,000 miles in sending ships to San Francisco. Guayaquil is brought 7,500 miles nearer New York, 8,500 miles nearer New Orleans, and 5,500 miles nearer Liverpool.

The western coast of South America comprises an immense territory rich at present, and likely with the development of trans-Andean railroads to become richer by its intercourse with Brazil and Argentina. Through Panama this vast territory will come in close relation with the commerce of the world. Without a watchful surveillance not only will its wealth be cast into the stream of commerce, but by the same channel yellow fever, plague, etc., with which some of its ports have been cursed, may also enter the current.

From New York and the North Atlantic ports of the United States, the distance to the Philippines and Hongkong by Panama is not much less than by Suez. The distance from New Orleans to Manila, about 13,000 miles by the Suez via Colombo and Singapore, is reduced to about 11,000 miles by the Panama route. New York is nearly 4,000 miles nearer Sydney, Australia, by way of Panama, than by Cape of Good Hope. The distance from New York to Australia is practically the same by Cape

of Good Hope as by the Suez Canal, and the Cape route has the advantage over the Suez of more favorable winds and currents and of a lower temperature.

The important sanitary effect of changes in ocean commerce brought about by the use of the Panama route is shown by a comparison of the distance between the Atlantic and the Pacific by the new waterway and by the routes at present in use.

The following table shows the distance by way of the Straits of Magellan and by Panama Canal from New York and from New Orleans to San Francisco and Iquique:

From New York—	By Magellan	By Panama
To San Francisco	13,714	5,299
To Iquique	9,221	4,021
From New Orleans—	**By Magellan**	**By Panama**
To San Francisco	14,114	4,698
To Iquique	9,621	3,420

For purposes of comparison in the table, New York has been selected as the principal Atlantic port of the United States; New Orleans as the chief Gulf port; San Francisco as the leading Pacific port of the United States; and Iquique, Chile, as the center of the nitrate of soda section.

Distance alone does not in all cases determine the routes of vessels; the cost of operating including port expenses, fuel, pilotage, tolls, etc., enters into the decision; but enough has been shown by a review of routes to indicate that immense changes involving sanitary problems of the gravest importance are impending.

The defense of Panama includes sanitary as well as armed defense. Sanitary guarding is not only a local protection in the case of Panama; it means an improvement of the hygiene of shipping throughout the world.

CHAPTER XLI

THE PROPOSAL TO COMPLETE THE CANAL BY CONTRACTORS' GROUPS

American Engineers Indifferent to Early French Operations—Spanish War Stirs up Patriotism—Contractors Eagerly Study American Canal Plans—Commission Consults Leading Contractors and Devises Plan to Construct Waterway by Contractors' Groups—Wide Variations in the Bids—Informal Bids—Rejection of All Bids—Civil Engineers and Contractors Give Full Credit to Col. Goethals and His Staff.

By Arthur F. MacArthur

TO the young engineer and constructor who was on the Isthmus of Panama in December, 1888, and witnessed the tragic dénouement of the work in the field of the "Compagnie Universelle du Canal Interocéanique de Panama" must have come some of the conclusions which came to the mind of the writer of this article, who was at that time a brief sojourner in the land where Count Ferdinand de Lesseps was the leading spirit. These conclusions were, in a word, that the acknowledged success which had attended the efforts of the great constructor in the joining of two seas in the Eastern Hemisphere had driven his luckless sun-chariot into oblivion under the tropical suns of the western world, and that the dream of three and a half centuries of establishing water communication across the Isthmus of Panama from ocean to ocean was at an end for at least a generation to come, if not forever.

No one could witness the destruction wrought by the then recent rains and not conclude, despite the charges of reckless and ill advised expenditures by the French company, which were apparently in evidence everywhere along the canal route, that after all, from a construction standpoint, the control of the flood waters of the Chagres River was the crucial test of the canal's feasibility. A continuous rain of two nights and days at that time had wrought ruin everywhere and apparently had put the active works and studies of a decade by the best-known engineers in the world, with their thousands of co-workers, fabulous sums expended, and thousands of lives sacrificed in the undertaking, into the archives of romantic history. Never was a more pathetic human story written on the faces of mortals than was read by the writer in the faces of those hapless thousands in camps along the canal route and on the streets of Colon and Panama and about the crowded lobbies of the hotels in those luckless days on the isthmus in December, 1888.

"L'honneur de France" was the most frequently uttered phrase on the isthmus in those gloomy hours. It was reëchoed throughout the whole French republic from club to peasant-hut, and it was a specious argument which pictured the revival of the enterprise and its completion at any sacrifice of men or means by the French government.

While the work on the isthmus by the first French company had excited some interest on the part of the American engineers at its inception, comparatively few found employment thereon, and during the construction and for the decade following the appointment of the receiver for the company, the American engineer or contractor rarely heard of and paid small heed to the undertakings on the isthmus.

Busied with plans and undertakings for all kinds of construction work in the development of our own internal waterways, railways, hydro-electric properties,

sanitation, and buildings, there was work at home for all the talent of engineers and contractors in the beginning of one of the greatest eras of construction work ever inaugurated in America. And it is therefore not surprising that the tremendous impetus to patriotism aroused by the Spanish War should not have to wait to find a most ready expression in the individuals who for one cause or another had been denied the privilege of fighting for the flag in Cuba or Manila, while busied in the great undertakings at home. Accordingly, when the first isthmian commission was appointed to consider the whole question of isthmian transit by navigation the engineering and contracting fraternity of the United States patiently waited to be called into service for the greatest single undertaking of all ages in the line of their chosen work.

The isthmian canal was to become an accomplished fact, a world work was to be done by Americans with American brains, brawn and money, for Americans and for all the nations of the earth for all time. And it was no uncommon interest which was manifested in the query: Would it be done by the administration and those trained in government service, and be carried on as an army undertaking; or would those supposedly most skilled by experience in each particular department of this most complex and exceptionally great work be called from among the ranks of the nation's best civilians, who were trained executives in construction work and who could offer the immediate benefit of efficient existing organizations to aid the country in its great undertaking?

The Spanish War had done much more than put upon a secure footing the peace and happiness of a few neighboring Latin Americans and distant islanders. It had suddenly made the undertaking of the construction of the Panama Canal by Americans a national necessity, and the war's experience had uncovered a relief from one of the chief causes of previous failure on the isthmus. The causes of malaria and yellow fever were no longer a mystery to science, and the medical profession was to play a prominent part in the construction and divide honors with engineers and constructors in the great work.

Men could now live and think and work on the isthmus through wet and dry months. The medical profession had already blazed the trail for successful accomplishment by the engineer and constructor, and the *bête noir* of the French, the Chagres River, vanished like its own rising miasma at noontide. The problem for the engineer and constructor was simply one of men enough, plant enough, time enough, and money enough, and the canal would be an accomplished fact at a cost which our government could well afford to pay.

Into the conferences of the Isthmian Canal Commission and the Board of Consulting Engineers, many of the leading engineers and contractors of the country were called from time to time, and after nearly three years of study, survey, and actual construction by the government, the waiting American contract world was rewarded for its interest in the matter by the suggestion that the government might soon consider the advisability of contracting the work of completing the canal by associating with the work of the commission the best trained talent of the world in each department of the undertaking; the plan contemplating a competition for the work between groups of contractors, each group composed of contractors who had achieved notable success in some of the departments of construction involved in the undertaking and whose combined experience covered the whole task, and whose reputations, like that of Cæsar's wife, must be above suspicion, and whose combined capital should be sufficient at all times to carry out their undertakings with the government.

For the formation of one such group of contractors, MacArthur Brothers Company were early invited, many months prior to

any public discussion of the matter and before any definite qualifications and requirements expected from possible bidders had been formulated by the commission.

Finally the question of contracting the completion of the work was discussed by the chairman of the Isthmian Canal Commission in a communication addressed to the Secretary of War, dated August 29, 1906. A copy of the communication was made public and submitted to prospective bidders, as indicating to them some of the reasons why the work was to be let to contractors, and the general qualifications and requirements which would be exacted by the government.

The widespread interest manifested in the work on the canal, which so far had been conducted under the immediate direction of the civilian chief engineers, one of whom had inaugurated the great work in its most trying period and stayed with it but little over a year, and whose successor was at this time barely entering upon his second year of incumbency, was now most naturally intensified in the public mind. When the announcement was made that President Roosevelt was seriously considering the placing of the completion of the canal under contract, the plan was interpreted by many to mean an admission of defeat by the government to its own organization, and dire results were predicted for the fortunes of any group of contractors who would enter into any partnership or dual performance with the government in this stupendous and risky undertaking. The enemies of the canal at home and abroad wisely shook their heads and rushed into print for a period.

Under the fire of such public discussion it was no easy task to enlist the interest of contractors in the groups desired by the government. Contractors of national reputation, achievement, and financial responsibility had to be induced by much argument, suggestion, and effort to join such a combination. The multiplied divisions of the work extended over a long series of years, and the necessary division of profits did not appeal to large contracting concerns, all of whom were profitably employing their capital and organizations at home. Millions of capital and credit was to be interested in the proposed groups, for a long time, under so many conditions of risk, attendant with the personal danger to health in the tropics, that contractors and capital became shy of the undertaking after their first enthusiasm had subsided. The first drafts of invitations to bidders and proposed forms of contracts were many times modified and finally withdrawn, after much discussion between the President of the United States, the members of his cabinet, the chairman of the commission, and the intending bidders.

The frankness and evident fairness of these discussions, in an effort to harmonize all views and obtain the best results for the government, with a fair compensation for the contractor with the minimum of risk, characterized all the discussions at which the writer had the honor to be present. But finally in pursuance of the general plan, invitations were publicly issued to bidders throughout the country under date of October 9, 1906, calling for the reception of bids January 12, 1907.

After many weeks of fruitless negotiation between groups of contractors, and within a very few days of the time set for receiving bids, it became evident that few, if any, groups of contractors throughout the country could be formed, or bankers enlisted into the groups for the undertakings proposed by the government. Accordingly the specifications and financial requirements were at the last moment very materially modified, cutting down the bond to be given by the contractors from $3,000,000 to $2,000,000, and the available cash capital required down to $5,000,000, which was always to be kept intact in the treasury of the contracting group.

Several hundred copies of the invitation to bidders and forms of contract were given out and received by and seriously

considered by the contractors of the country. And the widest publicity was likewise given through the popular and technical journals.

Bids from several competent groups were expected by the commission, as several tentative groups were known to have been formed for the purpose of bidding.

When it came, however, to the reception of the bids, while four bids only were presented, only one of them had complied with the terms and vital requirements of the invitations. That was the bid of the MacArthur-Gillespie Company, a group organized for the purpose of completing the construction of the canal pursuant to the invitation of the government, and composed of four of the most successful contracting concerns in the country. Each of the four concerns composing the group was recognized as having had a longer, wider and more successful experience in the field of contracting than any of the other bidders; and all had a larger experience in all the important branches of the work called to be done on the canal, and with a larger organization of trained and experienced men to draw from than all the other bidders combined.

For the successful, economical, and certain execution of the great work it was thought that the government had received in the bid of the MacArthur-Gillespie group the strength of the strongest and the skill of the most experienced contractors in the country.

The proposed contract for which the bidders tendered was based upon the theory of paying the contracting group the cost of the work which they undertook to perform plus a percentage for the risks assumed and profits expected by the group. The performance of the work, however, was to be a dual one by the commission and the contractor on a hitherto untried basis in the history of government contracts.

Large risks not incident to other government contracts were to be assumed by the contractor. It was difficult to determine what possibilities of risk might arise, and if they did arise by whom were they to be assumed. Some of the most important functions upon which the success or failure of the contractor hinged were specially reserved and retained in the control of the commission.

The method of estimating the cost and time for the construction of the canal and the work which the contractor assumed was to be determined by an engineering committee of five members, two to be nominated by the contractors, and three by the commission, of which three one should be the chief engineer of the commission. This engineering committee was to be nominated after the contract should be executed and after the contractor had assumed all obligations, backed with its bond and cash resources. To some contractors the whole principle of the contracting group idea reduced the actual doers of the work to mere employees of the government, whose pay would become most uncertain and whose capital and time would be jeopardized. It is not surprising, therefore, that only four bids should be received and that, considering figures only, they should have varied in expected compensation to the contractor, being in numerical order as follows: 6.75 per cent., 7.17 per cent., 12.5 per cent., and 28 per cent. The wide range in the tenders was obviously the measure of the varying estimates of hazard existing in the judgment of the bidders.

To the public mind it appeared remarkable that a bid made upon a percentage basis should afford opportunity for such a range of risk, but an intelligent examination of the contract provisions and conditions under which the contractor was to receive his final compensation will, in the light of our knowledge today, now that the canal is completed, and its cost ascertained, force the conclusion that had either one of the two lowest bids been accepted and the contract undertaken, the unfortunate group would have long since lost all its original $5,000,000 capital and several mil-

lions more, had it been able to progress with the work up to its nearly completed stage, or the government would have had a forfeited contract on its hands.

The bid of the MacArthur-Gillespie Company of 12.50 per cent., so strongly urged for acceptance upon the government at the time, would have resulted in dividends of patriotism to be distributed among its group.

There were doubtless contractors who would have undertaken the great work for a less percentage even than the so-called lowest bidder submitted, with the hope of snatching the first fruits therefrom and leaving the government in the lurch when the day of trial came. And well might the group of men who had submitted the only tender which complied with the terms and requirements of the invitations and specifications object to their efforts being laid aside, while serious consideration was being given to an informal tender. However, the right to consider an informal tender was reserved to the commission in the "General Instructions to Bidders," and thus by inference the warning to intending bidders against informality in their bids was nullified and the door left open for the commission to make the best trade it could for the government. This the commission sought to do with the lowest informal bidder, who upon his own suggestion was given time to qualify in the necessary financial and other requirements of the proposal, but not until after many formal protests had been made by able counsel in the interests of the MacArthur-Gillespie bid against such a proceeding, and oral arguments and printed briefs had been considered thoughtfully and fairly by the President and the commission in support of the contention for the right to the award, if any were to be made by the government, to the MacArthur-Gillespie Company, and not until after the writer on behalf of that company had in a personal interview with the President assured him of the hearty acquiescence by the group he represented in any procedure which would secure for the government the completion of the canal project on the wisest and most favorable terms to the country.

The rejection of all bids some days later, and the placing of the great enterprise again into the hands of the army engineers for completion by administration of the President through the commission, must now, after the years of successful accomplishment, meet with the unqualified approval of the American people.

It is far from one of the fundamental duties of good government that the action of its representatives should pursue the individual to his ruin. The suggestion to put this great national work under contract invited the possibility of such an outcome, and would have deprived the nation's faithful servants, the army, of participation in the glories of the actual accomplishment of the greatest single peaceful enterprise ever undertaken by any government.

The construction of the canal is now an accomplished fact, and well may the American engineers in civil life and contractors doff their hats to Col. George W. Goethals of the Army Corps and his group of trained constructors. They have proven themselves the silent, informal, and successful bidders for the contract which the President and commission might have overlooked had they not been looking for the best trade for the government with contractors.

CHAPTER XLII

THE NAVY AND THE PANAMA CANAL

National Policies Which Affect External Relations of the United States—Possible Antagonists in the Atlantic and Pacific—Outlying Possessions and Their Bearing upon Naval Requirements—Canal Shortens the Route of Naval Reinforcements by 8,000 to 10,000 Miles—Effectiveness of Navy Not Doubled by the Canal, but it Becomes a Great Military Asset—Advantages in Disposition of the Fleet—Great Saving Over Magellan Route—New Duties Imposed Upon the Navy by the Canal.

By Captain Harry S. Knapp, U. S. N.*

Note.—In the preparation of this History the Editor-in-Chief requested Admiral George Dewey to prepare a chapter dealing with the effect of the Panama Canal upon the United States Navy and naval strategy. Admiral Dewey was about to prepare such a chapter when his attention was directed to the appended article written by Capt. Harry Knapp, U. S. N., to which Admiral Dewey refers in the following letter: "My dear Mr. Bennett: Recalling our conversation relative to the bearing of the Panama Canal upon the naval development of the United States I have forwarded you a copy of an article on that subject written for the U. S. Naval Institute by Captain Harry S. Knapp, U. S. N., under the caption: 'The Navy and the Panama Canal.' Captain Knapp's views are in such complete accord with my own and are so clearly and convincingly presented, as to leave no occasion for separate comment on the subject on my part. Very sincerely yours, George Dewey."

THE completion of the Panama Canal is so nearly at hand that the time has seemed appropriate to the board of control to publish in the "Proceedings" a discussion of the effect of the canal upon the navy. In responding to their invitation to submit a paper on this subject the writer wishes at the outset to make plain that what follows represents his personal conclusions, and that he neither desires nor is authorized to speak for anybody but himself.

Because it has the widest appeal the question of how the canal will affect the strength of the navy will be considered first and at most length. To those outside of professional circles it has a more direct and personal application than any other, because upon the answer will depend the appropriations that the taxpayer must provide. The canal has been an expensive undertaking for the United States, and the people of the country, in thinking of its bearing upon the navy, naturally anticipate that its completion may considerably modify the appropriations for the upkeep of the naval establishment. Everybody is familiar in a general way with the shortening of sea routes via the Panama Canal from our Atlantic to our Pacific coast; for instance, that the direct distance from New York or Philadelphia to San Francisco is reduced from about 13,000 miles via Magellan to about 5,000 miles via Panama, or that the distance from New Orleans to San Francisco is about 9,000 miles less via the canal than via Magellan. From such general and obvious knowledge it is an easy step to the conclusion that the strength of the navy with the canal may be much less than it would necessarily be without the canal; or, what amounts to the same thing, that the appropriations for the navy may be greatly reduced as soon as the canal is opened. Twice recently within a week the writer has heard members of Congress refer to this very matter, one of them saying, in effect, that the canal would increase the effectiveness of the navy two- or three-fold, while the other thought its effectiveness would be doubled. The writer, while prepared to admit that these

*Reprinted from the Proceedings of the U. S. Naval Institute, September, 1913.

remarks were rather an after-dinner *façon de parler* than the expression of a deliberately formed opinion, yet believes they indicate a somewhat general impression that careful study of the situation will not justify.

A prerequisite to the formation of any intelligent conclusion on this question is an understanding of the conditions that govern the strength of the navy. The ultimate, dynamic, use of the navy is to beat the enemy in war; the every-day political use of the navy in peace is to avert war by reason of its existence ready for war. Neither purpose will be served unless the navy be adequately strong in material and personnel, and unless the personnel be trained and efficient; the navy itself is responsible for trained efficiency, but the country at large, through Congress, is responsible that adequate strength be provided.

Wars do not merely happen; they usually result from the clash of some definite policies. In an attempt to fix the strength of our navy the national policies of our government that affect other countries are a prime factor to be considered. The United States has the following definite policies in its external relations: 1st, the avoidance of entangling alliances; 2d, the Monroe Doctrine; 3d, the Open Door in the Far East; 4th, Asiatic exclusion; 5th, the control and protection of the Panama Canal itself. Where any of these policies affect adversely the interests of other nations there is the possibility of friction, and where friction arises there is always the possibility of war.

The first of the policies mentioned above may be dismissed with a word, for it is distinctly one of abstention, and so is not apt to be the cause of diverse interests. Its effect is, however, that we must play a lone hand, and that is not without a bearing on the strength of the navy. The second policy was recognized in a manner by England in the Clayton-Bulwer treaty of 1850, and to a greater degree in the Hay-Pauncefote treaty of 1901. But other nations do not accept it as international law, and it is not infrequently the subject of unfriendly comment. The Monroe Doctrine may be the occasion of friction, and so of war, with European nations, and there is a possibility that it may be with Japan, or at a later day with China. The relation of the Monroe Doctrine to the navy was pointedly indicated by Mr. Secretary Meyer, when he said in effect, for his words are not before the writer, that the Monroe Doctrine is just as strong as the navy, and no stronger. The third policy is one that may cause friction with both European and Asiatic nations. The fourth concerns our relations with Asiatic nations only. The fifth policy is a result of a duty we have assumed single-handed for manifest reasons of advantage, and we consulted no nation about it except Great Britain. It has a very direct bearing upon the strength of the navy, upon which it throws an added responsibility.

The extension of our foreign trade that is now being so urgently advocated in connection with the change of our tariff laws cannot be placed, perhaps, under the same head as the policies just mentioned. But foreign trade certainly does involve relations with foreign nations; and, as a matter of fact, commercial and trade rivalries are most fruitful causes of misunderstanding between nations.

What has just been said does not exhaust all sources of possible wars by any means, as it does not exhaust all our external relations. Enough has been said, however, to show reasons why war is not an improbability—certainly it is a possibility—with nations in Europe and Asia. European nations will hardly attack us in force in the Pacific, nor will any nation fronting on the Pacific be apt to attack us in force in the Atlantic. We have, therefore, to anticipate the possibility of war in the Atlantic with a European nation, and in the Pacific with an Asiatic nation.

This leads us to the formulation of a policy for the strength of the navy. It should be strong enough to safeguard our interests and meet any probable attack

in either ocean and not leave our interests unguarded in the other. In explanation of the last clause it may be said that a full consideration of the subject should not stop short of the possibility of a simultaneous attack in both oceans, however improbable; a war with allied nations in the Atlantic and Pacific is not impossible. It is especially the duty of men in the military branches of the government to have their eyes open to every contingency.

In considering possible antagonists in the Atlantic Great Britain may be eliminated from consideration. In the first place it would take us many years to catch up with her in material strength if we tried, and would entail an enormous expense; in the second, war would be a blow to her commercial interests and interests of supply that she can ill afford to suffer; and, in the third, we have a hostage in Canada worth many battleships. There are, moreover, powerful interests of a more sentimental nature that are yet very real. No such strong reasons exist for eliminating any other European nation from the list of possible antagonists and the formula therefore becomes, in its final and definite statement, that our navy should be strong enough to meet in the Atlantic the maritime nation of Europe next strongest to Great Britain, and in the Pacific the strongest nation in that ocean.

As affecting the strength of the navy it is well to keep in mind also the position of the United States in the two oceans. In the Atlantic, aside from the maintenance of the Monroe Doctrine, we have a great material interest in Porto Rico, which is our own territory; and toward Cuba and Panama we have a duty in the protection of their independence. Then there is the canal itself. All of these interests are comparatively near to us, and very much nearer than is any European adversary. In the Pacific we are in a very different case. There we have Alaska, the Hawaiian Islands, Guam, the Philippines, and Tutuila, the nearest 2,000 miles and the most distant 7,000 miles from our coast, and some much nearer possible adversaries in that ocean than ourselves. The distance of our outlying Atlantic interests has vastly less bearing on the strength of our fleet in that ocean than has the distance of our outlying Pacific interests on the strength of the fleet in the Pacific.

If the Atlantic and Pacific were closed oceans the formula reached above for the strength of the navy would mean that in each there should be maintained a force (that may be called the Standard Atlantic Fleet and the Standard Pacific Fleet, for brevity) sufficient for the duty in that ocean, which is the Two-Ocean Standard, pure and simple.

Neither here nor elsewhere in this paper will a concrete estimate be undertaken of the strength in numbers of ships of the "standard" fleets. Such an estimate is not reached by a simple matching of ship by ship, but is influenced also by such considerations as the probable situation of the theater of war, the possibility that the assumed antagonist may not be able to have his entire strength present in that theater for political or other reasons, and the morale of the antagonist. This may not impossibly result in the conclusion that our own necessary strength in ships is less than that of some possible antagonists and greater than that of others. For the present purpose no such concrete estimate is necessary and it is enough to say that the strength should be "sufficient for the duty."

Without the canal the requirements are practically the same as if the Atlantic and Pacific were closed oceans. For, though the possibility exists of reinforcement in one ocean from the other, yet the long distance to be traversed by the reinforcement by whatever route, the difficulties about fueling en route, and the danger, especially to a force coming from the Pacific, of finding the enemy between the reinforcement and the body it is attempting to join, all militate so greatly against a successful issue that it would be imprudent to count upon it.

With the canal in operation, however, a different situation arises. The route of the reinforcements will be shortened from 8,000 to 10,000 miles by the canal, and that route will lie on interior lines. Fuel can be taken at stations under our own flag, separated by distances less than those representing the sea endurance of the fleet; the embarrassment arising from the necessity of avoiding any semblance of violating neutrality in fueling will thus be avoided. Junction is possible from forty to sixty days sooner, and the enemy need not be passed to effect it. Put in another way: Guantanamo is at practically the same distance from the English Channel that it is from San Francisco via the canal; or again, the nearest Asiatic port to Honolulu is only about 1,250 miles nearer than Panama, but is about 8,700 miles nearer to Honolulu than our nearest Caribbean port by way of Magellan. In the face of such facts it would be difficult to maintain that the canal will have no effect on the strength of the navy, for that would be tantamount to the claim that the canal has no military value to the United States.

On the other hand, the claim that the canal will double the effectiveness of the navy or more is a great exaggeration. Though such statements probably result from loose use of language rather than a careful study of the situation, they are dangerous, for they are apt to be taken literally by the layman, and the navy cannot afford to have such an impression gain ground. To show their fallacy it is only necessary to consider the matter of distances. It is quite true that the canal will enable the fleet to be transferred from one ocean to the other in a few hours, but that is only the beginning of the problem. The added strength that the canal will give to the navy must be measured by the facility the canal affords in enabling reinforcements to arrive in time to be of use tactically; that is, as a part of the entire force in battle with the enemy. The canal will be of little use if the reinforcements arrive so late that the battle has already been won by the enemy. The Atlantic terminal is about 700 miles from Guantanamo, 1,200 miles from the most distant part of the Caribbean, and 2,000 miles from New York, no inconsiderable distances in themselves. On the Pacific side the condition is very much less favorable, for the Pacific terminal is about 3,250 miles from San Francisco, 4,700 from Honolulu, 8,000 from Guam, and 9,350 from Manila. Merely to be able to get the fleet rapidly from one ocean to another is a great gain, a very great gain; but it is not by any means the whole problem. Allowing the fleet an average speed of 12 knots from departure to destination, which is high, considering the time necessary to coal and effect repairs and the necessity that all the fighting components arrive together and ready for action, this means that, from the time of leaving the canal until it arrived where it would probably be needed, the shortest interval is about fifty-eight hours to Guantanamo, and the longest is about thirty-three days to Manila, during which the enemy will not have been idle. The canal will be a great military asset in war, and an equally great one in anticipation of war; but it is quite beside the mark to say it will double the effectiveness of the navy, or do anything approaching that.

The truth, as usual, lies between these two extreme views just examined, and the writer believes that the former is much nearer the truth than the latter. By its very nature the problem of determining just what will be the effect of the canal upon the strength of the navy cannot be mathematically demonstrated. The solution is largely one of opinion, and will be modified as greater or less weight is given to the several considerations on which it is based. If the general formula advanced above for fixing the strength of the navy be accepted, then manifestly, canal or no canal, the minimum permissible strength of the navy is that which will enable us to meet, with our entire force, our strongest probable enemy, wherever situated. Under the same conditions the maximum strength

that can be claimed as necessary is the sum of that of the Standard Atlantic Fleet plus that of the Standard Pacific Fleet (Great Britain being excluded for reasons above given). This amounts to saying that the maximum strength that can be claimed as necessary is that which will enable us to conduct a war with prospect of success in both oceans at once, which is the Two-Ocean Standard again. If the possible antagonists in the two oceans, in relation to whom our formula for strength is founded were equally strong, our minimum permissible navy would be half as strong as the maximum navy that will ever be necessary. They are not equally strong, however, and our Standard Atlantic Fleet should now, and the condition is probably permanent, be stronger than the Standard Pacific Fleet need be. The Standard Atlantic Fleet, therefore, is the measure of our minimum permissible strength; and, to avoid any misunderstanding, the words "minimum permissible strength" are used in the narrow sense of indicating the very least strength that can logically be believed allowable by anybody who believes in a navy at all for well-founded reasons. The quoted words do not represent the writer's views of what our minimum naval strength should be.

Our total naval strength at this minute is not equal to that of what is called above the Standard Atlantic Fleet. Hence the completion of the canal should have no immediate effect upon our building. It remains to find an answer to the question: What effect will it have upon our building policy for the future?

The writer's personal opinion is that, when the canal is finished, our policy should be to have eventually, and as soon as possible, a total strength not less than that of the Standard Atlantic Fleet plus three-quarters that of the Standard Pacific Fleet. These so-called "standard" fleets are not fixed quantities, but will vary from year to year as foreign nations increase their own naval strength. The policy itself can, however, be fixed, and some policy should be established.

The reasons that have appealed to the writer in reaching this conclusion are as follows:

(a) With no canal our total strength should be the sum of both the Standard Atlantic Fleet and the Standard Pacific Fleet.

(b) The canal so greatly shortens distances between the two oceans that some reduction of strength below that of (a) is justifiable when it shall be finished, in view of the great financial burden imposed by a great navy, and the rather remote possibility of simultaneous war in both oceans.

(c) This reduction should not be sufficient to leave the nation in a hopeless case in either ocean if war broke out there while war was being waged in the other.

(d) As the strength of the Standard Atlantic Fleet must be maintained in any event, the Pacific Fleet is the one in which to make the reduction in strength.

(e) Our interests are so great, and are scattered over such immense distances in the Pacific, that anything less than three-quarters of the Standard Pacific Fleet would make even a defensive war in that ocean hopeless.

(f) With three-quarters of the Standard Pacific Fleet a defensive war, a containing war, so to speak, would not be hopeless while waging a war on equal terms in the Atlantic.

(g) If there were no prospect of war in the Pacific at a time when engaged in war in the Atlantic, then one-half of the Standard Pacific Fleet, and perhaps less, would suffice to guard our interests in the Pacific, leaving the rest of the fleet in that ocean free to reinforce the Atlantic Fleet and give in the Atlantic a marked superiority of force.

(h) If at war in the Pacific with no prospect of war in the Atlantic, a great superiority of force could be maintained in the Pacific that would be the more valuable, owing to the distances over which the navy would have to operate in that ocean.

The composition of the fleet will be little affected by the existence of the finished

canal. All classes of fighting ships will be as much needed after the canal as before, and their numbers and proportions deemed requisite for the duty in either ocean will be necessary, canal or no canal. It is not improbable that the defense of the canal itself may demand a limited number of certain classes of vessels that would not otherwise be necessary. But in its large aspect the composition of the fighting fleet can hardly be affected by the completion of the canal. Even in the matter of auxiliaries the same thing appears to be true. If the navy depended upon its own auxiliaries for the transfer of supplies and fuel from one ocean to the other, the canal would naturally serve to diminish the number of supply and fuel ships; but such cargoes are practically all sent by contract. Other auxiliaries are based in number on the fighting ships they have to serve, and distance has little to do with the question. Speaking in a broad way, then, the existence of the canal will have no effect on the composition of the fleet.

It is more than probable that the completion of the canal will effect some changes in the disposition of the fleet in time of peace. It has already been pointed out that the navy is not now as strong as is theoretically necessary in the Atlantic alone; so that for a considerable time to come, whatever building program may be adopted, it will be necessary to concentrate our entire fighting fleet in time of war, trusting to Providence that the part sent to the threatened ocean will not be needed during the war in the ocean from which it is withdrawn. In effecting this concentration the canal will be a very great military advantage to us. In time of peace, however, the completion of the canal will enable some changes to be made in the present disposition of the fleet. The disposition now, while dictated by reasons of convenience under present-day conditions, is yet not very logical considered in the light of all-round preparedness for war. A very possible outcome will be the maintenance of a force of fixed strength in each ocean, with a shifting squadron that will go first into one and then into the other. This can be so managed as to keep in both oceans a force better balanced in all its components of fighting strength than is now the case with either. There will be other advantages also, one being the appearance on the Pacific coast of parts of the navy that cannot now be seen there. The people on the Pacific coast are as vitally interested in the navy as are those in the East; yet they habitually see the least powerful and least modern of our ships. It is natural and, indeed, commendable, that they should wish to have in their own waters at one time or another the flower of the navy. The completion of the canal will enable this to be done; and it will, further, be good policy for the navy to do it, and so stimulate the friendly interest in the navy that is always in evidence on the Pacific coast.

Another advantage that will accrue in connection with the transfer of ships from one ocean to another is the possibility of making between our own ports, and without taxing the hospitality of foreign nations, the long voyages in fleet that we believe in our service to be so advantageous as a means of fleet discipline and fleet preparedness. The entire battle fleet could easily go from New York to Seattle, stay ten days at San Francisco and ten in Puget Sound, and be back in New York in a little more than three months. As a long-distance cruise this would have many advantages over a cruise to Europe and back, not the least of which would be the experience gained in logistics over a route that the fleet may have to make some day in one direction or the other when the errand is not peaceful.

The completion of the canal will be advantageous to the navy in still another way connected with the disposition of the ships of the fleet. Corinto, Nicaragua, is less than 100 miles further distant from New York via Panama than it is from San Francisco. All the Pacific coast of Central America outside of Mexico is 1,000 miles or





1. U. S. Marines scaling a wall, Ancon Baseball Park, July 4, 1912.
2. Panama Railroad Dock Cristobal, showing Torpedoboat Destroyers.

more nearer Panama than it is to San Francisco. It will, therefore, be possible generally to send ships more quickly from the Atlantic to the Pacific coast of Central America in times of disturbance there than it will be to send them from San Francisco.

The preponderance of our naval strength will probably continue to be in the future, as it has been in the past, habitually kept in the Atlantic. That ocean is the better one for the upkeep, drill and administration of the battle fleet for many reasons. But the canal will permit of many changes of disposition, some of them permanent and some temporary, that will be advantageous and that are impracticable under present conditions.

The completion of the canal should serve to bring home to every one the importance of our naval bases in the West Indies and the Pacific. That their importance has not been adequately realized is evidenced by the lack of funds provided to put them in an efficient condition. The Monroe Doctrine was an old story before the war of 1898; but few people realized that it extended our military frontier beyond the Atlantic and Gulf coasts, for it is a mental conception and not a tangible thing appealing to the senses. After 1898 and the acquisition of Porto Rico there was a visible projection of our frontier into the Caribbean; and after the Hay-Pauncefote treaty in 1901, which gave the United States undivided responsibility for the canal, another visible and material interest appeared still further to the front. It has always been clear to the naval mind that our military frontier extends far beyond our continental borders, and now, irrespective of the Monroe Doctrine, it extends from the Atlantic coast around Porto Rico to the canal; and it has been equally clear that, for the security of that frontier, a naval base somewhere on the outer edge of the Caribbean is a necessity. After careful consideration Guantanamo was selected as the site for such a base as being the suitable harbor situated furthest to the front on the edge of the Caribbean. Congress has not yet signalized its appreciation of the necessity for Guantanamo by the provision of an adequate program for its defense and equipment, though there are some signs of such an appreciation. Nor do the people of some of the gulf states realize that the frontier has advanced more than a thousand miles from their coast, and that the New Orleans and Pensacola naval stations no longer serve any useful military purpose, if one may judge by their arguments against the action of the Navy Department in closing them during the last administration. When the canal becomes a great utility in regular operation instead of an interesting engineering work, when trade has settled into the new routes the canal will make possible, and when business men have occasion to think of it daily as a vital link in their transportation problems, a juster appreciation will arise of the necessity of a naval base at Guantanamo for the protection of the canal and of the trade routes converging toward it, as well as for the maintenance of our general interests in the Caribbean, that will doubtless find expression in a complete scheme for its defense and equipment.

If, as it almost surely will, the canal serves to place in the Pacific Ocean, even for a part of the time only, a greater force and one of larger ships than is now there, the question of bases in that ocean must be considered. In the Pacific, excepting our limited plant in the Philippines, there are three bases—Mare Island, Bremerton, and Pearl Harbor. To care for any considerable force in peace, and, what is more important, to care for it in war, these are all too few. Pearl Harbor is in the making, and Bremerton is not yet a first-class base. San Francisco Bay is the place above all others on our Pacific continental coast that is suited for a naval base by reason of its strategic situation geographically and the advantages attending the proximity of a large city. But the Mare Island Navy Yard is impossibly situated for this purpose. It has neither the area nor the depth of water needed for modern

capital ships and its distance from San Francisco and lack of a railway connection are handicaps in the supply of labor and in the economical handling of freight and building supplies. At the present time the available depth is twenty-two feet at mean lower low water, and the channels constantly and rapidly silt up. It is even difficult to keep the entrance to the new dry-dock deep enough for safe docking of ships that can enter it. The adopted departmental policy is to have forty feet depth from the sea to our navy yards, and that depth of channel is being urged at our important commercial ports in the interests of commerce. To all except those who will not see it has been increasingly evident during the last ten years that the Mare Island Navy Yard is doomed for the service of modern capital ships, and it is equally evident that a new location, somewhere in San Francisco Bay, on deep water near the city, must eventually be provided for their docking and repair. If the people of California desire and expect to see any considerable part of our modern fleet habitually visiting in their waters after the canal is finished, they cannot too soon bestir themselves to provide in the deep water of San Francisco Bay the naval facilities that are required for the supply, upkeep, and repair of modern capital ships. Mare Island does not afford them, for the simple reason that recent capital ships cannot safely go there, if for no other. Men cannot drive rivets on a ship twenty to thirty miles away. The completion of the canal should help to force this conclusion home if the people of California are not prepared to accept it now.

Of Pearl Harbor and Bremerton there is less occasion to speak in this connection. Congress is treating Pearl Harbor in a liberal spirit, and the facilities at Bremerton are gradually increasing. The development of both should go on to provide for the increased naval shipping that may naturally be expected to follow the completion of the canal; but, above all, to provide for the greatly increased demand upon them in the event of a war in the Pacific.

The consideration that perhaps comes most naturally to mind in connection with the canal is the immense shortening of distances effected by it in most cases between points in the Atlantic and Pacific. This consideration, was, of course, the reason for building it. What may be termed the commercial routes from New York to Hong-Kong, those that take in ports of call, are practically the same length via Panama and Suez, the difference between them being less than twenty miles in favor of Suez; but the Panama route is the shorter from New York to Shanghai and the ports of Japan. From New York to Manila the Panama route is shorter than that by Suez unless the former go by way of Honolulu and Yokohama. The further east the point in the Pacific, the greater the gain in distance to New York by the Panama route. Valparaiso is 3,750 miles nearer New York via Panama than via Magellan. Speaking generally, the distance is shortened via the canal from New York to any point in the Pacific inside of a line drawn from Magellan Strait, through Australia and the Philippines, to Hong-Kong. As affecting naval movements this means more than time and fuel saved, though both economies are of prime importance. It means the possibility of sending ships from the Atlantic to almost any place where they will be needed in the Pacific by a route that has fuel stations under our flag along the entire distance, no two of which are further apart than the fuel endurance of our capital ships. This is an enormous advantage, for the problem of fueling our naval ships in time of war on a passage from the Pacific to the Atlantic, or vice versa, would be a staggering one by either the Suez or Magellan route, and the attitude of neutrals might make it almost an unsolvable one. The canal will eliminate the question of neutrality altogether, and for that reason alone it is of incalculable benefit to the navy.

The question of economy is, however, one

not to be ignored. Between New York and San Francisco, in either direction, Panama and Guantanamo would probably be ports of call for a fleet. A study of the saving of time, fuel, and money effected by sending a fleet between Panama and Guantanamo through the canal instead of through Magellan gives some astonishing results. Such a study has been made, based on the movement of twenty-five capital ships with attendant cruisers, destroyers, and auxiliaries. It is too long to give more than the results, but they are sufficiently interesting.

The time saved under the assumption is about sixty days. This could be considerably shortened by increasing the assumed sea speed, or decreasing the days at anchor for coaling, repairs, and recuperation of the personnel, but at the expense of fuel burned, with the attendant cost and necessity of fueling oftener. The route via Magellan that the fleet would follow between Guantanamo and Panama requires nearly 900 actual steaming hours at twelve knots, or thirty-seven days. This makes no allowance for necessary time to refuel and repair, so that sixty days is not an unreasonable gain in time to allow in favor of the canal, in view of the fact that refueling on the Magellan route would have to be carried on at places outside the territorial limits of neutrals, and often under disadvantageous circumstances. This might be time enough to enable the enemy to finish the campaign in his favor, not to speak of the harassment of the personnel while making the long sea voyage via Magellan, during which every man would know that he and his ship were needed every moment of the time, with the prospect that the fleet would not arrive after all in time to effect its purpose.

The saving in coal is about 290,000 tons, and in fuel oil about 54,000 tons. At the present market values of these fuels taken for the conditions, this means a money saving of nearly $3,000,000. Not to overestimate this saving, and assuming that an oversupply of twenty per cent. has been allowed, the saving in coal would still be 240,000 tons, in oil 45,000 tons, and in money $2,500,000.

The gain in time is the all-important economy, but the saving in money is itself important. In view of our lack of a merchant marine, however, the simplification in the supply of fuel via the canal is of vastly greater moment than the money saving. The United States can furnish whatever money the circumstances of war may demand, but it cannot build overnight a merchant marine for the service of the fleet. This subject could be greatly elaborated, but enough has been said to show what a valuable military asset the canal is in its bearing on fleet logistics.

Simply for the ordinary service of the fleet in time of peace the canal will effect very large savings to the naval appropriations. A fair average price for eastern coal of a kind fit for naval use is $8.45 per ton at San Francisco, Puget Sound, and Honolulu. While no exact prediction can be made, competent authorities believe that when the canal is in operation the price at which eastern coals can be laid down at these places will not be more than $6.20 per ton. Taking as a basis the amount of coal on naval account sent to the Pacific in the last fiscal year, 160,000 tons, the saving amounts to $360,000. Nor does the advantage end there; a collier can take a cargo via the canal to the Pacific coast, discharge and be back at Norfolk in the time she would take to make the voyage out via Magellan. This roughly divides by two the tonnage necessary for any given supply of coal at those ports. In time of war in the Pacific, this will be of inestimable advantage, considering our woful lack of a merchant marine. With respect to other bulky naval supplies, like provisions, the same thing does not hold true, for they can be delivered equally well and at little difference in cost on either coast from their points of origin. Even ammunition and guns, which are practically all manufactured in the east, would very probably be sent by rail to the Pacific in order

to save time, though the expense would be greater. But with oil fuel, again, the advantage to the navy is apparent, and this time the gain is in movement toward the Atlantic. In the last few months the price of oil has markedly increased. California produces more oil than any other state and its price is lower than eastern oils. This fact, in addition to the important fact that a large oil-producing area has been set aside for naval purposes in California, points to the possibility that the navy may soon be using California oil in the Atlantic, which would hardly be possible without the canal. The demand for oil increases every day and many of the older wells are falling off in production; the navy may not improbably have great occasion in the years to come to congratulate itself that the canal will make the Pacific coast fields available.

Modifications of trade routes that will follow the completion of the canal are sure eventually to cause a reduction in freight rates, and so act as a stimulus to trade. The increased trade will, in turn, demand a greater tonnage, though this demand will be partially met at first by the ability of the same amount of shipping to provide for a greater trade because of the shortened distances via the canal. Still it can hardly be doubted that the opening of the canal will create a demand in time for an amount of shipping considerably greater than exists now in order to provide for the increased trade. The opinion has been advanced that the United States merchant marine will be greatly stimulated by the operation of these causes. The navy earnestly hopes that this may be true, for a large merchant marine is a necessity for a strong navy only in a less degree than the auxiliary ships especially designed for its service; and anything whatever that can properly be done to increase the merchant marine should have the active support of the navy. In so far as the coasting trade is concerned there seems to be good reason to expect an increase of United States shipping, for that trade is certain to grow rapidly upon the opening of the canal, and foreigners cannot take any part in it. Moreover, the exemption of this class of shipping from the payment of canal tolls will virtually be a subsidy. Already some ships have been built for this trade in anticipation of the completion of the canal, and others are being built. But the writer has been unable to convince himself that the opening of the canal will alone serve to draw American capital into a form of investment from which it has persistently kept aloof, and under present conditions and laws he anticipates little or no resultant increase in that part of the merchant marine of the United States engaged in foreign trade. Without any close examination of the reason why, it seems to be a fact that Americans either cannot or else do not care to compete with other maritime nations in the sea carriage of foreign trade, and it is not apparent that the opening of the canal will by itself change that condition. That we should have a flourishing merchant marine is a matter of such vital interest to the navy that it will anticipate with satisfaction the increase of shipping engaged in coastwise trade due to the opening of the canal; and, as remarked above, the navy should exert its influence in favor of every proper measure tending to put American ships on the ocean in the foreign trade.

However interesting and profitable it may be to dwell upon the military advantages to the United States attending the opening of the canal, that feature is not the most vital one to the navy. The canal puts an added and very great responsibility upon the navy, and this fact is one that the navy and its friends must always keep in mind.

The canal is being built, and it will be operated and controlled, solely by the United States Government. The protection of the canal, therefore, falls solely upon the United States. Moreover, in the Hay-Pauncefote treaty of 1901, the neutralization rules are embodied in Article 3, in which the language is: "The United

States adopts, as the basis of the neutralization of such ship canal, the following rules. . . ." We are, therefore, the sole guarantors of the neutralization of the canal. Again Article 1 of the treaty of November 18, 1903, with Panama, reads: "The United States guarantees and will maintain the independence of the Republic of Panama." Finally, the United States trade passing through the canal will be very great. Here are new and great responsibilities, all flowing from the canal, and all dependent upon the navy for their realization. The navy is the outer line of defense of the canal as it is of the country. The inner line of defense of the canal resides in the fortifications and garrison at the canal itself. If our navy is driven from the sea and made negligible an enemy with a great army can undertake with impunity the transportation of the troops necessary to overcome the inner line of defense and complete the victory begun on the ocean. The task may not be easy for him, but its possibility must be conceded if the sea is closed to us and open to the enemy. The only possible and final assurance of safety for the canal is in a navy strong enough to meet the enemy, beat him, and prevent him from ever getting near it. The following words, quoted from Admiral Mahan, indicate the alternative: "Permanent [naval] inferiority means inevitably ultimate defeat, which fortifications can only delay." And a few lines later he uses these words: "If the United States desires peace with security, it must have a navy second to none but that of Great Britain; to rival which is inexpedient, because for many reasons unnecessary."

The United States is not a military nation. There is little consideration and less understanding among the people at large of military matters. The Government has no defined military policy, using "military" in its wide sense, and it has no defined naval policy. By this is meant that there is no soberly thought-out relation between our military strength and our situation in the world—between our declared external political policies and the only means yet found efficacious to uphold them—that manifests itself as a guiding principle in Congress, or even in the recommendations to Congress. There should be such a military policy, and it should carry on from administration to administration, from Congress to Congress, and be considered a part of our foreign affairs policy, as little open to attack from within our own household as the external policies on which it is founded. Our form of government, the immensity of our country, and our isolated position, almost insular as far as other first-class nations having great military strength are concerned, all doubtless conspire to cause the general lack of interest of our people in foreign affairs, which is the ultimate cause why there is so little appreciation of the underlying need for a strong navy. The navy is popular just now, and to that degree it is fortunate; but the roots of its existence should lie in deeper ground than popularity. It is to be hoped that the completion of the canal may serve to broaden the national outlook, and that we may be able to look back to it in coming years as the period in which a reasoned national policy, founded on national aims, shall have had its birth in the country at large.

There would be no excuse for a failure of the navy itself to have a "reason for the faith that is in us"; nor can that reproach be laid at the door of the navy, which has for years had a definite, consistent policy as expressed by the responsible advisers of the Navy Department. Moreover, the effect of the canal upon that policy has been carefully kept in mind since the day the canal was started.

CHAPTER XLIII

THE DEFENSE OF THE CANAL ZONE

By Major-General Leonard Wood, U. S. A.

THE people of the United States in constructing the Panama Canal undoubtedly had in mind its great commercial advantage to the world at large; they realized that it would facilitate commerce, that it would bring certain sections of the west coast of North and South America into closer relations with Europe; it was looked upon as a great world benefit, one of those great works the beneficial results of which go to the betterment of mankind.

The American soldier and sailor at once saw in the completed canal an implement of tremendous military utility, and realized that it would enable the prompt transfer of our fleet from one ocean to the other, or the quick union of the fleet on either ocean. In a certain way it doubled our naval efficiency. It is now practically completed; and, like all great undertakings, it carries with it great responsibilities; it must be safeguarded. Its secure holding is of more importance to us than to any other nation; and consequently, we are confronted, from the military standpoint, with the problem of holding the Canal Zone securely, so that the canal may be always available to us, and not available to our enemies. With this end in view, careful and detailed studies have been made of the Canal Zone area; powerful fortifications are being constructed at each extremity of the canal, and the preliminary steps taken to provide a garrison adequate to hold it against any force, excepting such force as might be landed as a result of our losing sea power—that is to say, the garrison ultimately to be provided will be sufficient merely to hold the canal against raiding forces from fleets. If we should lose sea control so as to permit the free transport of troops by an enemy, then the force required to hold the canal securely would be a very large one. These are some of the aspects of the problem which confronts us.

The expansion of the United States into a world power has brought in its train many new responsibilities—responsibilities which thus far have been discharged with great good to humanity and with much benefit to ourselves, in that our occupation of tropical countries has resulted in discovering the method of transmission of yellow fever, and the means of its control. Through the application of this knowledge, yellow fever has been done away with, and the tropics made a white man's country for all time, so far as this disease is concerned. Yellow fever need no longer harass the Southern states; the great losses from widespread quarantine are no longer necessary. Great results have also been accomplished in the control of malaria and other widespread tropical diseases—results tending to increase the energy, and consequently the productive power of tropical and semi-tropical people, as well as that of the population of some of our Southern states.

The Canal Zone is a typical tropical area, with heavy forests and luxuriant vegetation. The problem of its defense involves many interesting features. Great care must be exercised in the sheltering and sanitation of troops. Officers and men cannot be kept advantageously in the tropics for more than a few years at a time. All this involves not only the maintenance of a highly efficient garrison, always equipped and ready to meet any emergency, but also a careful application of the latest sanitary principles.

CHAPTER XLIV

THE PANAMA CANAL FROM A NAVY STANDPOINT

INCREASED BURDEN OF PROTECTING CENTRAL AND SOUTH AMERICAN COUNTRIES UNDER MONROE DOCTRINE—THE FLEET PROTECTED BY CANAL FORTIFICATIONS—NECESSITY OF STRONGER NAVAL FORCES IN THE PACIFIC—ENGLAND'S ALLIANCE WITH JAPAN—NAVAL BASES IN THE PACIFIC—ENFORCING NEUTRALITY OF THE CANAL—THE RESERVE FLEET.

BY CAPTAIN PHILIP ANDREWS, U. S. N.

NOTE.—In accordance with Navy Regulations, permission to publish this article was requested by Capt. Andrews, and was granted by the Secretary of the Navy, in a letter dated Aug. 14, 1914, as follows: "Permission is granted you to publish without change your article entitled 'The Panama Canal from a Navy Standpoint,' submitted for scrutiny under Article 1534 (3), U. S. Navy Regulations, 1913. (Signed) JOSEPHUS DANIELS."

THE Panama Canal has been successfully built. It has been fortified. It is being operated commercially.

The doubts and controversies which preceded it, the difficulties of building, may now be forgotten and attention riveted on what it will do for the navy, the nation, and mankind generally. That the recipients of the canal's bounty are mentioned inversely in the order of their importance is because this article deals mainly with its effect on the navy, and only incidentally with the others.

In arguing for the building of the canal, the benefit to be gained by the freer use of our naval force in war or threatened war, was used to arouse patriotic and widespread interest in the canal, yet the material benefits to the United States in the easier exchange of commercial commodities, and to mankind generally, were of much greater importance.

The shortening of trade routes, the development of Central and South American states, through fuller emigration and commercial opportunity, the direct benefits to our sparsely populated Pacific coast in supplying labor, and the opening of new markets in the vast Pacific Ocean—one thinks of these at once as among the direct results of joining the two oceans.

Let us look ahead some years to the probable effect of the stimulus given Central and South America after the opening of the canal. It needs only a fair imagination to see what will happen. The trade to and from these countries will vastly increase, and they will become well populated by people from Europe and the United States, and probably even by Asiatics. Investments of foreign capital will be heavy. Until the native population is overcome by children of foreign blood, or intermarriage, the governments of some Central and South American states will not be strong enough to stand alone or to resist aggression, nor will they be stable. We must continue for years to exercise a suzerainty over them; and while protecting them against outside interference, require of them honest government and fair dealing among themselves and toward outside nations. Stable governments must henceforth be the rule, not the exception.

This, then, is the newer Monroe Doctrine. The United States protects, when necessary, Central and South America from interference from other nations, but it now demands and will enforce as necessary not only fair dealing with foreigners and stable government within, but a government which shall be founded on justice and the consent of a majority of the governed. This course will make for the ben-

efit of Central and South America, and equally for the United States and those other nations which have citizens and money invested in these countries.

The navy shares in the benefits conferred by the canal to a marked degree. The greatest benefit is the shortening of the distance between our Atlantic and Pacific seaboards. The seaboard frontiers of the United States are not only the Atlantic and Pacific coasts, but also the necessary water communication between them, for at times it will be necessary to send our naval force from one coast to the other. When there was no canal, our sixteen battleships of the Atlantic fleet went from one coast to the other by the Straits of Magellan; a long route but fairly sure. In war time even this would be feasible provided no greater force than ours was met, for the route is far from a base. With the Panama Canal in operation the distance is much decreased, the time even more; but safety is infinitely greater because the communications to the canal (or away from it) on either ocean are shorter and more easily defended. The safety of the fleet is also increased by the strength of the canal itself; the powerful guns at its entrances, the defense of the line of the canal by an adequate army force, and by the dry docks and repair shops at the disposal of our ships. Thus our ships may seek shelter behind the guns at the entrance as against a superior force, and safely await the arrival of more of our ships from the other side, or may all seek shelter in the interior lake of the canal while a part may be repaired or docked. The entrances are well fortified with heavy guns to keep off hostile vessels, so that our fleet, wishing to emerge to give battle to the enemy's fleet, can safely leave the entrance and form in line of battle before it can be reached by an enemy's guns.

If we have an enemy in each ocean, desirous of joining, we can at least go through the canal, reach one part and give battle before a junction can be made.

Until recently it was only necessary to have our main fleet in the Atlantic, where it seemed most likely international complications might arise. But the Pacific Ocean for some years has been steadily increasing in importance to us, and the two wars in which Japan has recently engaged have placed her and her policies in a position where careful statesmanship will be necessary to avoid controversy between us. This condition has been coming and would have arrived whether the Panama Canal had been dug or not, but the recognition of it was partly responsible for the building of the canal.

The canal has cut the distance from New York to San Francisco from 13,000 to 5,000 miles, and has reduced the time in even greater proportion than the distance on account of cutting out delays necessary for replenishing fuel. Our battle fleet, therefore, of whatever strength it may be, is rendered vastly more mobile by means of the canal, and can readily and quickly pass from one ocean to the other in case of need.

Before the opening of the canal, our fleet in the Atlantic should have been measured by our need for enforcing the Monroe Doctrine; in the Pacific by the strength necessary to share in the trade of the East and in enforcing Asiatic exclusion, for the time at least one of our definite policies. Thus both oceans would have ultimately demanded strong fleets suited to their necessities, and as commerce grew and competition became keener stronger fleets would have been necessary. The canal has made it possible for us to maintain a smaller battle fleet because it can pass quickly from one ocean to the other as necessary and be available for either.

It has been said that the building of the canal would double our navy, but this probably only meant that one fleet would suffice, instead of two which could rarely be joined, and then only after great delay. And the fact that naval forces, with no canal, would necessarily be divided and make it necessary to have each separate fleet of full strength, was a prime factor

in deciding that we should build the canal. It was, in fact, a military measure to reduce our ultimate expenditure for war vessels; an economy. It is immaterial here to conjecture what strength each fleet would have had without the canal; or what our one battle fleet will be with the canal. Both would depend upon the policies of other nations, and on their varying naval strength.

By what proportion the canal has increased our naval or military effectiveness can not be stated; it is more correct merely to say that it saves us from larger expenditures for war vessels, by requiring less naval strength to prevent wars, and to meet war, should it come.

In all probability a battle fleet suited in size for any contingency in either ocean will suffice for our needs. This means in effect that we should be approximately as strong as or stronger than Germany or France in the Atlantic, and stronger than Japan or China in the Pacific. Just as soon as our naval strength falls below that of any European nation that needs land for her surplus population, we invite, and may get, a defiance of the Monroe Doctrine. Indeed, the opening of the canal itself, by gradually increasing commerce and opportunity in Central and South America, will invite such aggression. Trade and colonization, in fact though not in name, will increase the interest of all nations in Central and South America. Even now, both European and Asiatic nations have large colonies in South America.

We have guaranteed the neutrality of the Panama Canal; we must maintain it by force if need be against any and all. We have bound ourselves to do this. What this may mean no one yet knows; the need for force on this score would probably arise at the same time as other difficulties.

We must prevent two nations at war from fighting in the canal, or near it at such distance as we may prescribe. We cannot allow the passage through the canal of belligerent vessels of one nation in pursuit of its enemy until a suitable time has elapsed, just as belligerent vessels of one nation are not allowed to depart from the same port until twenty-four hours after its enemy's vessels have left.

One circumstance remains which is at once an embarrassment and a source of security to us, and might affect materially our need for naval strength—England's offensive and defensive alliance with Japan. It means baldly that England will join Japan in case she cannot persuade her to go it alone, or refrain from war. It is certain that England's close commercial dependence on us in the way of investment, and her reluctance to part with Canada, would lead her to advise against war with us, but the possibility is there. It is equally certain that wise Japan does not wish war with us or with any nation. Her greatest need for successful development lies in many years of peace, and wisdom to cope with her serious internal problems and her financial condition.

With our battle fleet in the Pacific a large part of the time, as it will be, the extension of our naval bases becomes necessary. We now have Mare Island in California, and Bremerton in the State of Washington, and a small coal pile at San Diego. Our facilities for repair and outfit of our ships on the Pacific will be entirely inadequate when the battle fleet gets in the Pacific for any length of time. The navy yard at Bremerton must be increased and a first class naval base established on San Francisco Bay, the natural strategic center of the Pacific Coast. It is probable even that a naval station must ultimately be established in southern California, for the length of our Pacific seacoast is about 1,200 miles. With this purely navy yard development will probably also go the establishment of a torpedo station for manufacture, repair and test of torpedoes, and possibly even a powder factory and facilities at one of the navy yards for manufacture and repair of guns.

With the increase of naval facilities on the Pacific Coast will come a diminution in the number of navy yards on the Atlantic

Coast. We have now two on the Pacific Coast and eleven on the Atlantic Coast.

We will have in the canal itself ample docks and shops for the repair of our ships, but necessity will force the development of Guantanamo, on the southeast side of Cuba, and probably will urge the establishment of a coaling and naval station on the Pacific between Panama and San Diego, a long distance of 2,840 miles.

These are all on our coasts or on the line from coast to coast, but our responsibilities point still westward. Pearl Harbor in Hawaii is approaching completion. It is the great outpost of our Pacific Coast whose possession is vital to us, and it must be denied an enemy. It is also a vital link in our line of communications to the Philippines, which if we retain, will also require the fortification of Guam as the next step. Then a minor naval base will be necessary in the Philippines.

Smaller questions which will undoubtedly arise after the opening of the canal will be the necessity on the Pacific Coast for increased barracks for the larger number of men needed, increased facilities for oil fuel and coal, and provisions and supplies. This will mean more storehouses, barracks, fuel depots, and additional expenditure for equipment and supplies for the fleet when in the Pacific.

It will be necessary to make some rearrangement of the reserve fleets, probably balancing each with the different elements usually in a standard fleet. It is likely too that additional torpedo vessels and submarines of a more modern type will be transferred to the Pacific Coast. We already have torpedo vessels and submarines in the Philippines, and submarines in Hawaii. Guam, too, will get its quota of both for local defense.

The Atlantic reserve fleet is based at Philadelphia and the Pacific reserve fleet at Bremerton Navy Yard. Both are composed of the older vessels which would form the second line, and perhaps be the final reliance in war should it happen that our main battle fleet had met the enemy and been disabled, or in need of repairs even if victorious. It has been well said that the nation which can quickest get its reserve fleet of older and less formidable ships to the front will decide the war finally in its favor. Any modern action is bound to disable the greater number of vessels on both sides; it is necessary, therefore, to keep our older vessels in good repair in reserve, with reduced crews ready when needed.

The political situation may easily render it necessary to transfer either reserve fleet to the other coast, a contingency which would require more men than we now have, for we have not yet enough officers and men to man all our effective vessels.

Take it all in all, the opening of the Panama Canal will be the beginning of great development and progress in which the navy will follow and share; as always a necessary adjunct for peace, which must be as strong relatively as the interests it guards and preserves.

CHAPTER XLV

OUR FOREIGN COMMERCE

COMPARISONS OF FOREIGN TRADE OF LEADING COUNTRIES—COMMANDING POSITION ENJOYED BY UNITED STATES—IMMENSE SIZE OF HOME MARKET—LESSONS OF THE EUROPEAN WAR—CHANGED CHARACTER OF AMERICAN EXPORTS—TRADE BALANCES—CONSTRUCTIVE LEGISLATION NEEDED—COMBINATIONS AND FIXING PRICES IN FOREIGN TRADE SHOULD BE LEGALIZED—MERCHANT MARINE—AMERICAN INVESTMENTS ABROAD—EFFECT OF PANAMA CANAL UPON AMERICAN COMMERCE—BAD FINANCIAL CONDITIONS IN SOUTH AND CENTRAL AMERICA AND CHINA—AMERICAN ASSISTANCE NECESSARY—PAN-AMERICAN SUPREME COURT SUGGESTED—PAN-AMERICAN DEFENSIVE ALLIANCE AS A SUBSTITUTE FOR MONROE DOCTRINE.

BY JOHN HAYS HAMMOND

IN the year 1913 the total commerce of the world was $40,468,000,000. These figures in the main relate to net imports and domestic exports. They do not relate to any single uniform year, but are for the latest year available. The following figures show the foreign trade for the year 1913, of three leading countries:

	Exports	*Imports*
United Kingdom	$2,557,000,000	$3,742,500,000
United States	2,428,500,000	1,813,000,000
Germany	2,403,311,000	2,563,354,000

The foreign commerce of the United Kingdom, the United States, and Germany combined equals about thirty-seven per cent. of the total commerce of the world. In respect of an export trade, the United Kingdom leads, very closely followed by the United States, which in turn is approximated by Germany.

It is because of the magnitude and diversity of our home market that we have heretofore made, comparatively speaking, but desultory and inadequate efforts to extend our foreign markets. The position we hold to-day in the world's foreign commerce is most reassuring as to the opportunities presented to us in the future development of foreign trade. We have achieved this commanding position in the world's export trade, for such it virtually is, despite lack of systematic effort, handicapped by inadequate banking and transportation facilities, and without the valuable assistance rendered to their nationals by the governments of our competitors. Having regard to these facts, there can be no doubt of the remarkable potentiality of the United States in this field of commercial activity and of its inherent capacity to become eventually the dominating factor in the world's commerce.

It has not been through lack of ability on our part that we have not already achieved this position, but because our incomparable home market has been able to absorb the products of our national industries, for which reason we have not been compelled, as have Great Britain and Germany, to assiduously develop an export trade. *The value of the products absorbed by our home market is about twice as much as that of the total exports of the world.* Within the small area of Greater New York alone, for example, the value of manufactures annually exceeds the exports of either Great Britain or Germany. These figures show in a striking way the magnitude of our national industries. Not only in the value, but in the diversification of our industrial products, we hold a position incomparably more important than any other nation in the world.

One of the economic lessons of the present war is the complete vindication of the fiscal policy which has resulted in the building up and expansion of our great national industries. We learn more clearly the interdependence of our industries, the vital dependence, for example, of the great industry of agriculture on the prosperity of the manufacturing industry; for in the manufacturing centers it finds its best market. We learn the importance of all of our industries to the extensive classes employed in our great transportation systems, in our agencies of distribution, etc., and we must conclude, therefore, that *the keynote of our economic and fiscal legislation must ever be to preserve unimpaired the integrity of our home industries and the purchasing power of our domestic markets.*

With a rapidly increasing population, and especially a rapidly increasing number of wage-earners, we must extend our industrial activities; but we must, nevertheless, not lose sight of the fact that overextension in industry inevitably causes depression in times of business recession. Indeed, authorities agree that we are now rapidly approaching the limit, that is to say, the point of saturation in our domestic markets, at least in so far as present demands under normal conditions are concerned. It is obvious, therefore, that we must either curtail the capacity of our factories, which would result in throwing out of employment millions of wage-earners and the disorganization of complementary industries as well, or we must depend upon the exploitation of foreign countries for the relief of our congested home markets.

In the character of our export trade there has been a significant change in recent years. As late as the year 1901 foodstuffs constituted nearly seventeen per cent. of our total exports, whereas, a decade later, in 1911, foodstuffs formed only about five per cent. of the total exports. On the other hand, a very encouraging phase of our export trade is the rapid increase in manufactures exported. In 1901 manufactures (and manufactures for further use in manufacturing) represented but 31.8 per cent. of our entire exports, whereas, in 1911, 44.5 per cent. of our total exports were manufactures. Conformably with this change in character of exports we find a gradually diminishing percentage of manufactures imported, but, on the contrary, the importation of a rapidly increasing percentage of crude materials for use in manufacturing. The recently enacted (Underwood) tariff has unfortunately resulted in an increased importation of manufactures, and the present war has stimulated the increase of food exports, but both these factors are to be regarded as aberrations only in our commercial history.

The bulk of the exports of Great Britain and Germany has been wholly or partially manufactured articles, eighty per cent. of the exports of Great Britain and sixty-five per cent. of the exports of Germany coming under this category. Therefore, our future competition with those countries will be almost entirely confined to exports of that kind. In her foreign trade Great Britain follows the line of least resistance. She sends to British colonies and possessions, where she enjoys preferential tariff rates, nearly forty per cent. of her entire exports, while only thirty per cent. is sent to other manufacturing countries having a protective tariff; and of the remainder of her exports a large part is sent to neutral markets, where there is no competition from home industries. Germany and America, on the other hand, have succeeded in developing the bulk of their trade with countries which have highly organized competitive industries in the same lines of merchandise; *i.e.*, America and Germany have "bucked the center" while Great Britain has "played the ends."

In the year 1913 the United States had a "favorable" trade balance of about $615,000,000; but, as a matter of fact, there are "invisible exports" that tend to wipe out this apparent credit balance. These are, ac-

cording to Prof. Jeremiah W. Jenks, First: $225,000,000 on account of payments of loans made to this country or of interests and dividends due on investments made here, the United States being a debtor nation to Europe, it is estimated, to the sum of about $5,000,000,000. Second: Money drawn on letters of credit and other forms of foreign drafts by Americans traveling or residing abroad, amounting, according to Sir George Paish, to a net sum of about $170,000,000. Third: Funds remitted abroad for investment by immigrants residing in this country. These remittances, it is estimated, amount to from $150,000,000 to $250,000,000 annually. Fourth: Remittances by American manufacturers and merchants for payment of freight shipped in foreign bottoms, estimated at a net sum, after deductions, of about $25,000,000. These are the "invisible" exports, the amount of which is a factor in determining the net balance of our national commerce.

England, Germany, and France (*i.e.*, the peoples of these nations) have a large debit, so-called "unfavorable" trade balance, owing to the fact that they are creditor nations and receive from the debtor nations increased imports which represent the interest due them for foreign loans and investments.

In competing with foreign markets we are to meet our great trade rivals, who, by years of experience and by the expenditure of colossal sums, have obtained a foothold more or less firm in the markets we seek. Therefore, to successfully compete with these nations we must secure for ourselves every advantage we can derive from the most efficient exploitation of our national industries, fostered by constructive legislation at home and promoted by able commercial diplomacy abroad. This has been notably the policy of Germany, and its success is evidenced by the unparalleled strides she has made in the development of her great foreign commerce.

I have referred to the stimulus of constructive legislation at home. It is not my wish to inject politics into a discussion of this kind, and I therefore disavow criticism inspired by partisan motives. As a matter of fact, both of our great political parties are transgressors. It is indeed unfortunate that the solution of great problems purely economic in character should not always be entirely dissociated from politics; that legislation dealing with the tariff, currency, trusts, and other economic subjects vital to the welfare of the whole nation is, on the contrary, determined on strictly political lines—settled, indeed, by politicians on the stump rather than by business men in boards of trade. Economics is too often subordinated to politics. The vehement attacks on corporations by high officials of our government, indiscriminately impeaching the integrity of our corporate practice and of our business men, has not only prejudiced our position as exporters in foreign markets, but has increased also the difficulty of obtaining foreign capital indispensable to our industrial activities. This has a far-reaching consequence, having regard to the fact that we have borrowed from abroad upward of five billion dollars for the development of our home industries. It is by excess of exports that we are able to pay the interest on this large sum and to gradually wipe out our indebtedness. There has been much unintelligent prejudice, partly inspired for political purposes, against what we call "big business," but the people of the country should be convinced that unless our industries can be developed on large scale production, as is the practice of our great European trade rivals, we shall be seriously handicapped in our quest for foreign markets. England permits, France encourages, and Germany sometimes even compels, combinations in the interest of the industry and the general public. Governmental intervention was of great advantage to the potash industry in Germany, and the more recent intervention of the Government to prevent cutthroat competition between the Hamburg-American and the North German Lloyd lines was

undoubtedly most beneficial to German stockholders.

In the enforcement of the Sherman law, our government should remove, as far as possible, obstacles to the cheap production of commodities for our export trade, so as to place our country at least at no disadvantage compared with our competitors. Coöperative combinations, and the fixing of prices for products exported, should be allowed to enable the smaller industries to more advantageously exploit foreign fields. Then, too, it should be legal for transportation companies to give special rates to the seaboard for products destined for shipment abroad.

In making future tariff revisions, we should endeavor to obtain reciprocal advantages from nations profiting by such revisions.

One of the practices that has been much criticised is the sale of our products abroad at lower prices than at home, but this practice is justified because of the fact that we are dealing chiefly with our surplus products, especially in times of depression. The alternative policy would be to close down the mills. By so doing the effective organization which has been built up would be impaired and likewise many wage earners would be thrown out of employment.

So great is the interdependence of the commercial nations of the world that we find in times of depression in this country similar conditions prevailing in Europe, and consequently congested home markets for their products.

To compete successfully, therefore, with the minimum prices of our European competitors in foreign markets, it is often necessary, especially under conditions referred to, for us to make lower quotations abroad than those at which the same commodities are sold at home. This is the practice of European nations. A further vindication of such policy is that by securing the foreign trade which would otherwise go to our competitors we are enabled to retard the expansion of their industries, and in that way to prevent them attaining the low costs of production that we ourselves enjoy; and after all, in the long run, the maintenance of the maximum production of our mills results in an average price in our home market lower than could be attained by operating on a smaller scale, and for that reason the consumer gains rather than loses.

An American merchant marine would be most valuable in the development of our foreign trade. To-day only ten per cent. of our foreign commerce is carried in American-owned vessels, ninety per cent. being carried in vessels for the most part owned and controlled by our trade rivals. The advantage of direct and frequent sailings is important in the development of trade relations; but, while this is true, many of us do not approve of steamship lines being owned or controlled by the government, as it would obviously deter private investment in lines which would be subject to competition by government-owned vessels. The rehabilitation of our merchant marine can best be accomplished by private enterprise after the necessary amendment of our navigation laws and the provision of subventions, etc., to compensate for the subsidies to their nationals by other governments. According to the Hon. Oscar W. Underwood, "All of the great shipping nations of the world are to-day granting subsidies in one form or another to their ships passing through the Suez Canal, except our own government. Already two of the shipping nations are providing subsidies for the ships passing through the Panama Canal, and undoubtedly the other shipping nations will shortly adopt the same policy."

Far more important than an American merchant marine is the extension of American banking facilities in foreign countries. This is now made possible by the recently enacted Federal Reserve Act, and the National City Bank of New York is to be commended for the enterprise it is showing in establishing branch banks in South America. The investment of a nation's

capital abroad is of great advantage in the expansion of its commerce. It is indeed the "open sesame" to the nation's export trade. The investment of British capital in the nature of loans to foreign governments (with the collateral advantages usually obtained for its nationals in the way of commercial concessions), and for the development of the resources of those countries, amounts to about $750,000,000 annually. It is estimated that more than $20,000,000,000 of English capital has been invested abroad, (about $5,000,000,000 of which represents investments in Latin America) bringing in an income of $1,000,000,000 annually. This refers to the remunerative investments only.

One of the fundamental requisites for successful competition for the world's markets is low cost of production; and in this connection it is well to disabuse the mind of the public of the long-cherished delusion as to the tremendous superiority of American labor, Yankee ingenuity, and American machinery over those of all foreign countries. The fact is, that this superiority no longer obtains in the same degree as formerly, for the reason that technical training abroad and the introduction of American machinery have already minimized the advantage that American industry formerly enjoyed in this respect. When this situation is realized there can be but little doubt that for their own protection American wage-earners will be compelled to increase their efficiency, so as to make possible the maintenance of the American standard of living, and at the same time lower the cost of production so as to enable our country to compete successfully with our trade rivals for foreign markets.

One of the essentials of efficiency in production is industrial peace. This is too large a subject to discuss at present, but, while realizing the complexity of the problem, I do not believe that I am too optimistic in expressing the opinion that the relations between employer and employee are better to-day, fundamentally, than for many years past. The employer appreciates the justice and also the advantage, when properly conducted, of the principle of collective bargaining, and both the employer and the employee recognize more than ever before their interdependence and their reciprocal obligations as well; and with the spirit of fairness that generally prevails we have every reason to believe that the labor agitators, on the one hand, and unreasonable employers, on the other, are destined to become less serious obstacles to industrial peace. The people of the country of all classes, irrespective of political affiliations, are beginning to recognize the fact that politicians have, in a large measure, by their indiscriminate and demagogic attacks on the corporations controlling national industries, created a lack of confidence which has contributed to periods of depression. For that reason there is to-day a strong revulsion of feeling throughout the country against the attitude of such legislators, and I believe we have every reason to hope that the compelling force of enlightened public opinion will, in the future, result in legislation facilitating, rather than, as has hitherto been the case, obstructing the processes of industrial development, while, at the same time, adequately safeguarding the interests of state, community, and individual.

Another important problem indirectly affecting our trade is that of the curriculum of our public schools. The policy of our public school system is in a large measure directed to the preparation of boys for college and the university, subordinating the importance of preparing them for some efficient service in industrial and commercial pursuits. This is obviously wrong, and inexcusably so when we consider the small percentage of pupils that enter the colleges and universities after graduation from the high schools. At least the curriculum of the public schools should be arranged so as to better equip the graduates to earn their livelihood in commercial and industrial vocations. I believe that boys should have less erudition and more

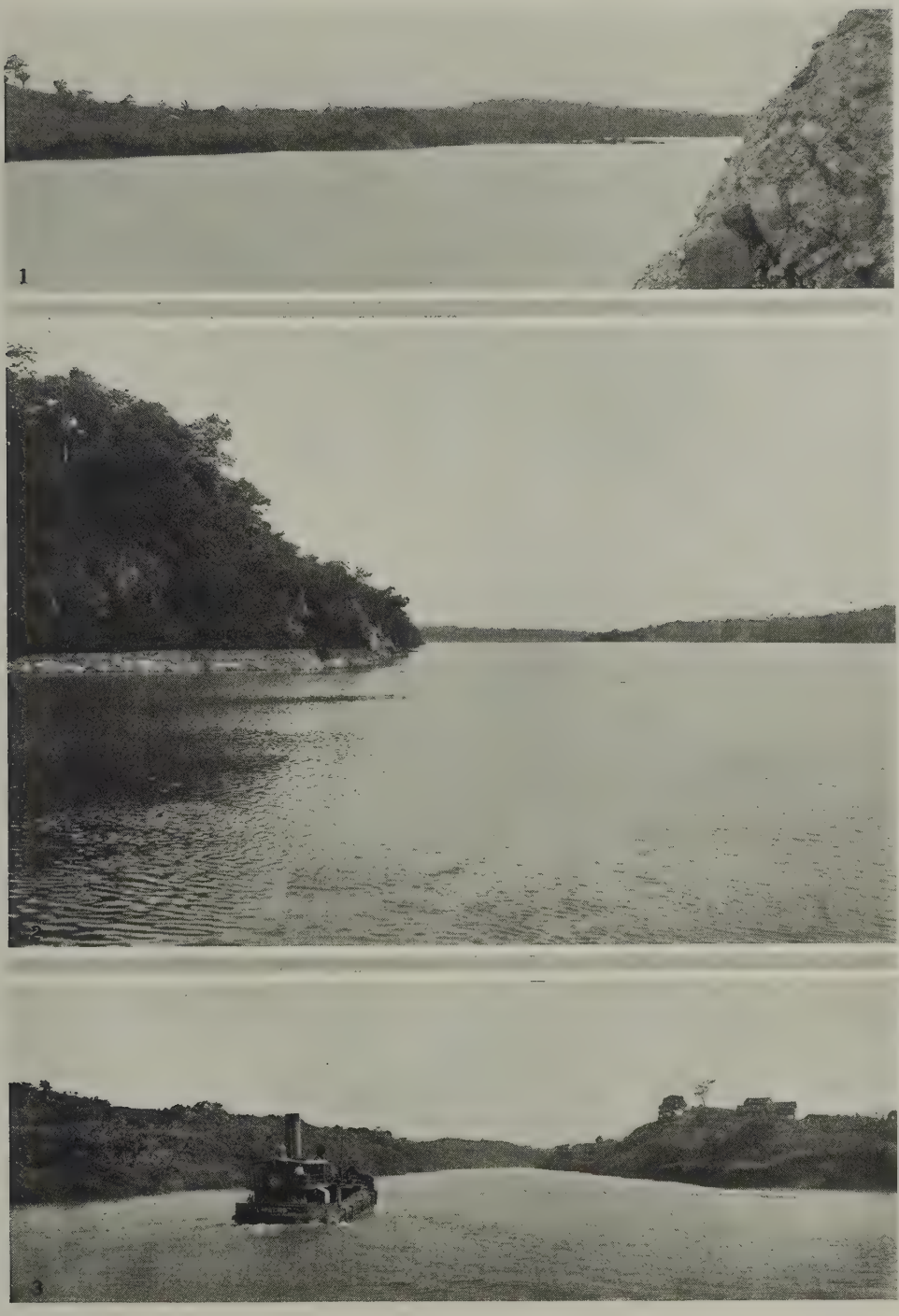
knowledge. We should remember that "he is idle who is not best employed," and that there are far too many young men educated for professional life who add to the already congested ranks of the professions, and whose energies could be far more profitably expended in other vocations. They should be included in the producing, rather than in the non-producing class of the community.

During recent years our consular service has been greatly improved, and it reflects credit upon our country; but there is still room for improvement, and I would advocate that in the selection of men for that service some consideration be given to their qualifications for future service in diplomacy, so that in the selection of ambassadors, men who have attained distinction in the consular service should be available.

Coincident with the declaration of war in Europe considerable enthusiasm was evoked, verging indeed on hysteria, in the agitation to build up our export trade in South America. The opening of the Panama Canal has also given a stimulus to this movement; but, lest we repent at leisure, it behooves us to "make haste slowly" in our efforts to expand our trade with Latin America. While the Panama Canal will be of great advantage to this country in the development of foreign commerce, it will not facilitate our trade with Mexico, Central America, or with the northern and eastern sections of South America, with the exception of that commerce to be developed between our Pacific Coast states and those points. The Panama Canal will eventually add immensely to our foreign commerce in the Orient, and will be of incalculable advantage to our Pacific Coast trade, but in the future, as in the past, the bulk of our South American trade will, I believe, be with the South American states on the Atlantic and not with those on the Pacific Ocean.

The immensity of the area of the South American states, aggregating 6,850,000 square miles (or nearly twice that of continental United States), with a population of almost 35,000,000, appeals to the imagination of our manufacturers, merchants, and exporters; but there are important problems, financial, engineering, social and economic, to be solved before the potentialities can be realized. In 1912 South American exports amounted to $1,176,971,000. The imports amounted to $960,504,000, of which $153,000,000, or about sixteen per cent., was from the United States. The total South American imports slightly exceed in value the sum of the exports of the United States to the United Kingdom and Canada alone; less than half the value of the manufactured products of Greater New York, and not more than one-fortieth of our domestic trade. These figures further emphasize the magnitude of our home market.

In order to develop our Latin American trade, with characteristic impetuosity and strenuosity we agitated the instantaneous creation of a merchant marine as a first step. We did not realize that the lack of a national merchant marine was by no means the greatest obstacle to the immediate development of our South American commerce. We ignored the "absorptive power" as well as the far more important factor, the "purchasing power" of these states. Hardly more than a cursory investigation of this subject suffices to show that we cannot expect substantial returns from this field in the near future. The financial conditions in South America at present are unfortunately decidedly adverse. This state of affairs exists likewise in China, Central America, and many other countries, not entirely due to but greatly aggravated by the European war. The fact is, many of these countries have borrowed from Europe sums far in excess of their ability to repay for some time to come. Some of this money has undoubtedly been wasted, but the greater part has been expended in industrial and commercial undertakings which have not as yet reached the period of fruition. Even before the war many of these countries were in financial



These three views show typical sections of the canal completed and under water. All of them lie between Gatun Lake and the deep section of Culebra Cut.

distress, but the war has greatly aggravated this condition by causing depreciation in the value of their products owing to lack of European markets.

If we are eager to promote the extension of our Latin-American trade, we must be prepared to assist in financing the governmental necessities and also the requirements for the completion and expansion of the industries and commerce of those countries. It will be a long time, undoubtedly, before European capital will be available in requisite amounts for that purpose. Under conditions existing before the war our country was able to secure comparatively cheap money from abroad for its industrial needs, and thus would have been able at that time to finance in a measure the development of the natural resources of Latin America with the profits derived from the exploitation of our home industries financed by European capital. Undoubtedly the time will come when American capital will seek extensive investment in the development of the industries of the newer countries, and from that investment will result a proportionate increase in our foreign trade. If, however, American capitalists are to assume the rôle of banker and broker for Latin-America, we must reverse our governmental policy in many respects. We must, for example, encourage and assist our manufacturers, merchants, banks, and transportation agencies in "drumming up" and building up foreign trade. To do this we must have the cordial and competent coöperation of the Department of State. The government must cease to stigmatize Americans who invest their money abroad in foreign industries as unprincipled exploiters. We must rather emulate the example of Germany in its systematic and stimulating coöperation with the citizens of that country in their activities in foreign lands. Above all, we must guarantee to our citizens at least the same degree of protection as to life and property accorded the citizens of other nations by their governments. To obtain cheap money, which is required for commensurate industrial development, the Latin-American nations must guarantee the security of investment of foreign capital against discriminatory laws and confiscation, especially in times of revolutionary movements.

To attain the confidence of American investors and to obviate the serious objection that exists to investments in some of the Latin-American countries, I would advocate the creation of a Pan-American Supreme Court, to deal specifically with and to decide disputes as to foreign investments in Latin-American states. Such a court should be composed of leading jurists of our own and of the Latin-American nations, and should sit in neutral territory. If inspired only by self-interests the aim of such a court would obviously be to establish confidence as to the security of Latin-American investments, and for that reason foreign investors would be assured of fair treatment. Such a court might be one of final resort. In any event, it should try cases and endeavor to adjudicate claims before resorting to diplomatic agencies, a practice which almost invariably results in friction and often in extreme tension.

Cordiality of feeling between nations is essential to advantageous commercial relations, and it is for this reason that many of us advocate the substitution of a Pan-American Defensive Alliance for the Monroe Doctrine in South America. There no longer exists the necessity of maintaining this doctrine as applied to the whole of South America. The people of that country resent the "big brother" position as supererogation on our part. We should, I believe, restrict the application of the Monroe Doctrine to the states of Central America, to Mexico, and to the countries in the Caribbean Sea area.

CHAPTER XLVI

THE EFFECT OF THE PANAMA CANAL ON HAWAII

COMPARISON OF TRANSPACIFIC ROUTES FROM PANAMA TO YOKOHAMA, VIA SAN FRANCISCO AND VIA HONOLULU—SUNSHINE BELT VS. FOG BELT—SOUTHERN ROUTE SHORTER IN TIME, WITH CHEAPER COAL AND QUICKER DESPATCH—ATTRACTIONS TO TOURISTS—CLIMATIC ADVANTAGES—IMMIGRATION QUESTIONS—THE SUGAR INDUSTRY—EFFECT OF THE TARIFF—COMPARISONS WITH OTHER SUGAR-PRODUCING COUNTRIES.

BY LORRIN A. THURSTON.

THE question is asked, "What effect will the opening of the Panama Canal have on Hawaii?"

The answer to this question lies in the future; but there are known facts which warrant drawing certain conclusions in advance.

The traffic through the canal which will directly affect Hawaii is of two kinds, viz.:

1. That which is bound to or from the Asiatic Coast and adjacent islands, which needs a way station for supplies or instructions, and

2. That which makes Hawaii its direct objective point, in connection with local freight or passengers, or through tourist excursions.

The all important question to Hawaii is: "Will steamers operating between Panama and the Asiatic Coast make Hawaii a port of call, or will they prefer ports on the Pacific Coast or in Alaska?"

A number of articles on this question have been published in which it has been argued that no steamer operating over the routes indicated will call at Hawaii—San Francisco or Dutch Harbor in the Island of Unalaska being given the preference.

The chief reason upon which this argument is based is that the distance between Panama and Yokohama, for example, via Honolulu, is greater than via San Francisco.

This claim, as to distance, is correct. In order that there may be no question as to the exact facts, I compile the following figures from the U. S. Weather Bureau Map of the North Pacific for December, 1914:

SOUTHERN ROUTE (via Honolulu)	
Panama to Honolulu (Great Circle Route)	4,685 miles
Honolulu to Yokohama (Great Circle Route)	3,394 "
Total distance Panama to Yokohama via Honolulu	8,079 miles
NORTHERN ROUTE (via San Francisco)	
Panama to San Francisco	3,277 miles
San Francisco to Yokohama (Great Circle Route)	4,536 "
Total distance Panama to Yokohama via San Francisco	7,813 miles
Distance in miles in favor of San Francisco	266 miles

Admitting a handicap of 266 miles against Hawaii, why should ships go by the long route?

The reply is that in shipping routes as well as lovers' walks by moonlight, "the longest way round is frequently the shortest way home."

The "short line" argument ignores the fact that many things affect and decide routes of travel besides distance.

There are good reasons why the bulk of transpacific Asiatic commerce will go via Honolulu instead of via San Francisco, in spite of the 266 miles handicap against the former.

Some of these reasons are given hereunder. There should be kept in mind, in

this connection, the location of the several steamer routes across the North Pacific.

There are three distinct lines of steamer travel across the Pacific, north of the equator, between the American and the Asiatic continents, viz.:

(1) The southern route, via Hawaii, is in the northeast trade-wind belt, advertised by the Pacific Mail Steamship Company as the "Sunshine Belt," from the fact that the sun shines along this route during the great majority of the days of the year, and that the normal wind is a gentle breeze varying from ten to twenty knots an hour.

Since white men have visited them there has been nothing in the nature of a typhoon or hurricane in the Hawaiian Islands. Even heavy gales are few and far between, and fog is not known there.

The Hawaiian Islands and the surrounding ocean are the most favored spot, climatically, on earth.

(2) The northern route, from San Francisco, is along the Great Circle line. This is known as the "fog belt," for the reason that fog is prevalent there during the greater part of the year. The prevailing wind along this line is from the west, and, as a rule, considerably stronger than the trade winds of the southern route. Violent storms are also prevalent along this line.

(3) The central route begins at San Francisco, but abandons the Great Circle route and its short distance of 4,536 miles, for a course considerably to the south thereof and making a distance to Yokohama of 4,791 miles, an increase in distance of 255 miles over the northern short line route. This line is recommended by the hydrographic bureau at Washington to steamers crossing the Pacific from San Francisco. The object in taking this longer route is to escape the fog, violent winds and currents and storms of the northern route. It is another demonstration that "The longest way round is the shortest way home."

A fourth route from Portland and Puget Sound parallels the second route, further north, but this route need not be considered in connection with the question at issue.

The foregoing demonstrates that although, theoretically, the northern route is 266 miles shorter than the southern, the route actually to be sailed is within eleven miles as long as the southern route. Without looking for any further reasons, the supposed advantages of the northern "short line" route disappear right here. All that remains to be done is to catalogue the many advantages which the southern route, via Hawaii, has over the northern route, via San Francisco.

The following are submitted as reasons why most of the steamers crossing the Pacific from Panama to the Asiatic Coast, which do not have specific business at San Francisco, will travel via Hawaii:

The sea is normally smooth and the winds gentle on that portion of the Pacific extending from Panama to Hawaii, and from Hawaii to the Asiatic Coast.

On the other hand, the normal weather on the northern route across the North Pacific involves high seas and stormy winds.

The bulk of transpacific traffic will be carried on in comparatively low-powered freight steamers, making ten to twelve knots an hour, to whom boisterous weather conditions are a serious hindrance.

A few days of heavy weather, bucking head seas and winds, and the racing of the propeller as it is pitched up out of water, will use up far more fuel and time on the shorter rough route than will be expended on the longer but smoother route.

Stormy, rough weather is in every way detrimental to economical steaming; tends to rack, strain and otherwise injure the ship, with the possibility of wetting and otherwise injuring the cargo, regardless of what direction the wind is from. Under these conditions, other things being equal, or even against a considerable handicap, the smooth water and gentle wind route will be chosen.

It is a fact known to all navigators of the Pacific, and demonstrated by the

records and charts compiled and published by the U. S. Weather Bureau, that the normal wind along the "southern route" across the Pacific, north of the equator, *i.e.*, the route via Hawaii, is the northeast trade wind, *i.e.*, it is normally a fair wind for ships going from Panama to the Asiatic Coast.

On the other hand, the normal wind along the "northern route," *i.e.*, the Great Circle route from San Francisco, is a strong westerly and northwesterly wind, with frequent gales, which winds extend well down toward the Mexican coast, *i.e.*, the wind is normally adverse to ships bound to the coast of Asia. The same general conditions, differing only in degree, prevail upon the central route.

The difference in a ship's progress made by an adverse or a fair wind is but little on a short voyage; but the difference in favor of 8,079 miles of fair wind by the southern route as against 7,813 miles of head wind by the northern route, or 8,068 miles by the central route, will not only nullify the theoretical 266 miles handicap, but leave a credit besides, in favor of the southern route.

The prevailing ocean current along the southern route is from east to west, while on the northern route it is from west to east, bending to the south when it reaches American shores and extending well down the Mexican coast.

The weather bureau observations show that along the southern route the current runs westward at a rate of one-half to three knots an hour; and that on the northern route it runs to the eastward at a rate of from one-half to two knots an hour.

To be conservative, estimate the average rate of current on both routes at one knot an hour.

A steamer making ten knots an hour will steam 240 miles a day; at which rate, if there were no current, favorable or unfavorable, it would take her thirty-three days steaming from Panama to Yokohama. With a current of one knot an hour, equal to twenty-four knots a day, she would gain, on a voyage of thirty-three days, thirty-three times twenty-four knots or a total of 792 knots.

On the northern route, if there were no current either way, other things being equal, it would take a ten-knot boat thirty-two days to cross from Panama to Yokohama. With an adverse current holding her back at the rate of one knot an hour, or twenty-four knots a day, the voyage would be prolonged thirty-two times twenty-four knots or the equivalent of 762 miles; equal to three days' extra steaming.

In other words, a steamer will, by reason of a favoring current, gain 792 miles on the southern route, and by reason of adverse current, lose 768 miles by the northern route, or a total handicap, by reason of currents, of 1,560 miles in favor of the southern route as against the northern.

The type of steamer under consideration burns about thirty-five tons of coal a day. Six days extra steaming would, therefore, involve burning 210 more tons of coal, amounting at $8.00 a ton, the average San Francisco price, to $1,680 for extra coal alone, besides other expenses and losses easily amounting to as much more.

In the face of these figures the 266 miles of theoretical handicap against Hawaii again disappears and the apparent handicap again changes sides. It is as though what appeared to be a mountain in the air had become a hole in the ground.

It may be thought that the points above made concerning storms and adverse winds and currents are purely theoretical. This is not so. There is scarcely a year goes by that some steamer bound across the North Pacific for Asia does not limp into Honolulu more or less crippled and short of fuel, after days and weeks of bucking the tempests of the northern route, here to replenish and pursue her way rejoicing along the "sunshine belt."

A concrete instance occurred only recently. The steamer *Strathdon* left Puget Sound on November 2, 1914, bound for

Japan. She should have reached her destination not later than the 19th. On the 21st she arrived in Honolulu out of fuel, her captain reporting such a succession of heavy seas, storms and head winds that he could not reach Japan. He recoaled and proceeded via the southern route.

The writer well remembers an arrival of the Pacific Mail Steamer *Rio de Janeiro* at Honolulu (the same steamer which later struck a rock and foundered while trying to enter San Francisco Harbor in a fog). Portions of her deck houses had been demolished and part of her masts cut away for fuel. She had arrived within 800 miles of Yokohama via the northern route, when, owing to the heavy adverse winds and seas, the fuel supply was so depleted that the captain decided he could not reach port, and ran for Honolulu, which he reached only by means of using his deck houses and masts as fuel.

Practically all of the Pacific Mail and Japanese Mail line steamers plying between San Francisco and Yokohama now travel the "sunshine belt," via Honolulu, although it is 5,474 miles that way, instead of the direct, "fog belt" route, although it is only 4,536 miles by that course. In other words they prefer a course which is 938 miles the longer.

The entire North Pacific is beset with fogs during the greater part of the year. The U. S. Weather Bureau charts show fog prevailing during forty per cent. of the time in this vicinity during some months of the year. Fog is especially prevalent at the port of San Francisco.

One of the favorite arguments of the northern route theorists is that Dutch Harbor, on the Island of Unalaska in the Aleutian Islands, will make an ideal midway coaling station for the Panama-Japan route. Examination of the facts shows this claim to be an absurdity.

In the first place, Unalaska lies over 300 miles north of the Great Circle route and is thereby out of consideration. Again, the port named is not only located at the storm center of the North Pacific, but is one of the foggiest in the world. It is not infrequently so beset with fog that for days and even weeks at a time, navigation is almost suspended in its vicinity. It is useless to belittle fog as an obstacle to navigation.

Few vessels attempt to enter or leave San Francisco in a fog, and those that do so, incur heavy risks. Fog conditions are responsible for a never ending series of wrecks and disasters. The *Rio de Janeiro*, which struck a rock and sank just outside the Golden Gate some years ago, is only one of a long series of victims to the fog terror of the North Pacific.

As against this deterrent to safe and economical commerce on the northern route, fog is unknown in the latitude of Hawaii, from Panama to Japan and China. The weather bureau charts demonstrate the correctness of this statement.

The mariner upon the southern route is certain that, day or night, whatever obstacles there may be to navigation will be visible; and seeing an enemy is half the task of conquering him.

The variation of the tides at Hawaii is only about fifteen inches. It is only two feet in extreme spring tides. As a result there are no violent currents to be reckoned with in entering the harbor, going to or from the wharf; there is no waiting for high tide on the bar; there are no delays of any kind due to tides or currents.

At San Francisco, on the other hand, the tidal variation is from five to eight feet, resulting in constantly changing and strong currents, constituting a hindrance to rapid manœuvering and a menace to safety.

Only last year a Pacific Mail liner was held up in San Francisco nearly all night while a diver cut away a cable from around her propeller which had become entangled while trying to straighten her course against a swift tidal current.

But recently the Oceanic steamer *Alameda* ran hard aground at Fort Point, in the Golden Gate, having been thrown off her course by a violent eddy during a few moments while the fog suddenly formed and obscured the view.

It is conservative to estimate that fog conditions alone will, on the average, prolong a voyage by the northern route, over one by the southern route, by at least a day.

There are two ports of call and supply for transpacific steamers in Hawaii, viz.: Hilo and Honolulu.

At Hilo the entrance to the harbor is a mile wide and forty feet deep. There is no entering channel and no obstacle to navigation. Ships can enter and leave by day or night.

At Honolulu the entrance channel is only half a mile long and 400 feet wide, with a minimum depth of thirty-five feet at low water. The channel is buoyed and lighted on both sides throughout its entire length. There are no obstacles to navigation. The harbor is entirely land locked and smooth, and the wharves are directly opposite the main entrance. There are no navigating or climatic obstacles to prevent a vessel entering or leaving the harbor at any time of day or night.

On the other hand, at San Francisco there is a bar across the entrance to the harbor about seven miles outside of Golden Gate, which prevents steamers of large draft entering or leaving at low tide in heavy weather. The Golden Gate is also seven miles from the foot of Market Street, the center of the shipping district. It is seldom that large ships enter or leave San Francisco after dark, and if they do so, it is at considerable risk.

The best quality of coal, available for commercial use in either San Francisco or Honolulu, comes from Australia. It is not of as good quality as the coal from the eastern states, but the latter can only be brought to Honolulu for commercial use in American ships, freight rates on which are so much higher than the rate on foreign ships that it cannot compete with Australian coal.

By reason of the 2,000 miles further haul to San Francisco from Australia, Honolulu is able to sell coal to steamers at about a dollar a ton less than the San Francisco price. That Honolulu has the advantage over San Francisco in this respect is evidenced by the fact that the Pacific Mail Steamship Company buys as much of its coal in Honolulu as can be taken aboard during the time that its ships are in port.

As to coal loading facilities, Honolulu possesses the best in the Pacific. The Inter-Island Steam Navigation Company owns a dock at which automatic machinery can load over 100 tons of coal an hour, into an adjacent ship, and has also two floating automatic coal conveyor barges with a capacity of 500 and 1,250 tons respectively, one of which can discharge 100 tons and the other 200 tons an hour. They can be concentrated on one vessel if needed.

Two British steamers came into Honolulu December 8, 1914, one of them en route from Panama to Yokohama, and the other to Vladivostock. They each called for 500 tons of coal. One began loading at nine o'clock and the other at ten o'clock A.M. Both finished coaling at four o'clock P.M. One left the same afternoon at five o'clock and the other stayed over night to clean her boiler tubes, but for which she also would have left the same day.

I interviewed the captains of both steamers and asked them why they came via Honolulu instead of via San Francisco, the latter being the shorter route.

The captain of the steamer bound for Vladivostock replied, "Because the northern route is stormy, and both wind and current would be against me the whole distance, while the southern route has pleasant weather and a favorable wind and current. By taking the southern route I can get to my destination not less than two weeks sooner than I could by the northern route."

The captain of the steamer bound for Yokohama gave the same reasons and said also, "I can get coal cheaper and get much quicker despatch in Honolulu than I can in San Francisco."

To Hawaii oversea commerce, the arrival and departure of deep sea ships, is the alpha and omega of its commercial exist-

ence. Everything that it imports and everything that it exports passes by sea. Every one who goes anywhere and every one who comes from anywhere travels by sea.

These conditions have created a habit of mind, a spirit and method of treatment of shipping that markedly characterizes Hawaiian ports.

At Honolulu, especially, where all commercial as well as social life hinges upon, circulates around, and is vitally affected by oversea connections, arrivals and departures, promptness of inspection, despatch and service, are the rule and take place as a matter of course.

An instance is given above of two British steamers arriving off Honolulu at seven in the morning; securing pilot and harbor master service; passing health and customs inspection; entering and clearing; each buying and loading 500 tons of coal; securing necessary commissary supplies and leaving again at five o'clock in the afternoon of the same day. It is inconceivable that such despatch could be secured at any principal mainland port. In fact the captain of one of the steamers named stated that at the canal all he could get was 180 tons of coal a day.

Incidental to this question of preparedness for despatch, Honolulu is equipped with an up-to-date steel floating dry dock, owned and maintained by the Inter-Island Steam Navigation Company. The dimensions are: Length, 352 feet; inside width, seventy-six feet at bottom, eighty-four feet at top; draft over keel blocks, twenty-three feet six inches; dead weight capacity, 4,500 tons. The dock is built on the unit plan, and will be enlarged as required.

There is also immediately adjoining the dry dock the Honolulu Iron Works Company's plant, a fully equipped foundry, boiler and iron works. The equipment includes planers which can handle objects twenty-two feet long; foundry to make fifteen ton castings and lathes to accommodate objects fifteen feet long and five feet in diameter, while any kind of boiler work can be manufactured or repaired. A full stock of plates, fittings and engineering and ships' supplies is maintained. The works are capable and make a specialty of repairs to ships and their machinery.

It is submitted that, whether Hawaii is the half-way house for all of the through transpacific business or not, enough has been shown above to demonstrate that it will not become the sequestered Sleepy Hollow of the world, as some predict; but that it will get a fair share of the benefits to be derived from the tide of commerce which will, within the next few years, sweep past our shores.

It will be noted that two of the reasons above noted apply directly to westbound ships only, viz.: reasons numbered two and three, relating to direction of winds and currents. The other six reasons stand, however, as to ships going both ways.

Effect of the Canal upon Local Traffic and Conditions in Hawaii

Intelligent understanding of this subject requires a brief résumé of the location of and conditions in the Territory.

Hawaii is not a "possession," a "colony" or a "dependency." It is a full fledged Territory of the United States, subject to the obligations and entitled to the privileges of that status.

It is located 2,080 miles southwest of San Francisco, its nearest neighbor, and has an area of 6,649 square miles, equal to 4,127,000 acres. This area is a little larger than the States of Connecticut and Rhode Island combined, and a little smaller than the State of Massachusetts.

There are eight principal islands, extending over a distance of three hundred miles, running southeast and northwest. There are a number of small islands and reefs extending westerly for a thousand miles.

Honolulu, the capital and principal port, is located on the Island of Oahu, about the middle of the group. Two active volcanoes are on the island of Hawaii, 200 miles from Honolulu.

The islands are almost entirely volcanic in formation, being tops of mountains rising 15,000 to 20,000 feet from the bottom of the Pacific Ocean, to heights varying from 4,000 to 13,825 feet above sea level. The two highest mountains are nearly always capped with snow.

The moisture laden winds blowing in from the warm ocean meet the high, cool mountains, and cause excessive condensation on the windward side of the islands, resulting in heavy rainfalls and erosion of the mountains, thus creating a great number and variety of valleys, precipices, waterfalls, and jagged mountain peaks; covered in places with forest and jungle, luxuriant as in any tropical country; and elsewhere contrasting with barren peaks thousands of feet high, of an alpine character. The arable land is chiefly in the valleys and along the sea coast.

Hawaii appeals to the stranger from many standpoints. Its grand mountain scenery; its magnificent precipices; its waterfalls, falling sheer a thousand feet into blue ocean; its awe-inspiring active volcanoes; its sea bathing; its surf-riding; its social life and up-to-date conveniences. But after all, the one point upon which it can preëminently base its claim of superiority over every other country, is its climate.

Hawaii is located in the same latitude as Cuba; but is, on an average, ten degrees cooler, for the reason that while Cuba is surrounded by the warm Gulf stream flowing northward from the equator, Hawaii is surrounded by the ocean current which sweeps up from Japan past the Alaskan coast, where it becomes thoroughly cooled, flows on down the coast of California and Mexico, and thence returns back across the Pacific, still retaining a portion of its coolness, thereby giving Hawaii a subtropical climate in a tropical latitude.

The stock statistics of countries which advertise climate as an asset, is that "the average temperature" is so-and-so; thus, while the maximum temperature may be 100 degrees and the minimum freezing, it is entirely correct to say that the average temperature is sixty-six degrees, which sounds very comfortable. The real test of climate is the actual—not the average—variation between the maximum and the minimum on any given day or month.

There are countries which vary in temperature each day as little, or even less, than in Hawaii; but such countries are in the low tropics, with a uniformly high temperature. Hawaii's claim is, not only that the variation is slight, but that the temperature is uniformly comfortable.

For thirty years weather records have been kept in Honolulu, showing the daily variation in temperature. It is unnecessary to publish the full record, but the following table, showing the highest and lowest tem-

TEMPERATURE RECORD FOR 1913, DEGREES F., HONOLULU.

	Highest Temperature on First Day of the Month.	Lowest Temperature on First Day of the Month.	Variation for the Day.	Highest Temperature for Whole Month.	Lowest Temperature for Whole Month.	Variation for Whole Month.
January	77	63	14	78	60	18
February	72	64	8	77	60	17
March	76	59	17	80	59	21
April	78	68	10	81	64	17
May	79	68	11	84	64	20
June	82	67	15	84	67	17
July	83	73	10	86	71	15
August	85	74	11	86	70	16
September	83	70	13	85	68	17
October	84	72	12	84	61	23
November	83	68	15	81	65	16
December	77	70	7	79	59	20

perature on the first day of each month, and for each whole month, during 1913, is a good index of Hawaiian climate.

The direct result of this slight variation of temperature between midnight and noon is a mildness and balminess in the atmosphere which gives it a soft, velvety touch and texture, and permits outdoor life all the year round without danger to health. It is this outdoor life and the ability to engage in outdoor sports without intermission, that puts the young men of Hawaii at the forefront of athletic sports both at home and abroad.

The champion swimmer of the world is Duke Kahanamoku, a Hawaiian boy who never received any instruction before breaking the world's record for both fifty and a hundred yards.

Although Hawaii has only a few boys at a time at colleges on the mainland, for years past Hawaii has had from one to three or four representatives on the football and baseball teams and rowing crews in the big varsities on the mainland. Their selection is purely on merit, and shows an astonishingly high percentage of efficiency when it is considered that they are chosen in competition with thousands of young athletes from the mainland. Their proficiency is largely due to the favorable climatic conditions under which they have developed.

Another fact, not altogether peculiar to Hawaii, but still a marked feature incidental to its climate, is that each island is so mountainous, rising from 4,000 to nearly 14,000 feet above sea level, that a few minutes to a few hours will take a person from the climatic conditions above noted to that of many degrees lower, even down to freezing.

The writer has cut ice ten inches thick on the first of August on the top of Mauna Loa, packed it down, and had ice cream made therewith in the low country before dark of the same day.

It may be well asked, "What has the foregoing description of Hawaiian scenery and climate to do with the Panama Canal?"

The question is well put. This is the answer:

The remarkable climatic conditions; the beautiful scenery; the possession of the necessities and luxuries of civilized life, together with its easy accessibility, have already made Hawaii one of the Pacific's great tourist resorts. The opening of the Panama Canal will make it a great world resort.

For several years past, round the world tourist steamers have made Hawaii an objective point. Two were due here last winter, but were prevented from coming by the war. These steamers have heretofore been compelled to come two-thirds of the way round the world, by the south of Asia, or by rounding South America.

With the opening of the canal, all of the great touring steamship lines which run excursions to the Arctic, the Mediterranean and the East and West Indies will be provided with a short cut to "the Paradise of the Pacific." Hawaii will be within two weeks direct steaming of New York and three of London and Paris.

A direct result of the opening of the canal should, therefore, be a radical increase in tourist travel to Hawaii. In fact, I look for care of the tourist to soon become, next to sugar production, the chief industry of the islands.

The opening of the canal will revolutionize immigration to Hawaii. To understand the significance of this point, a brief reference to the island population and labor conditions is necessary.

When Captain Cook discovered the Hawaiian Islands, he estimated the population at 400,000. This was probably an exaggeration, for upon the first official census taken in 1831, the record showed but 130,313 persons.

The population continued to rapidly decrease, until in 1872 it was found to be only 56,897. Meanwhile the sugar industry was rapidly growing, and required a large number of field laborers. The resident population was entirely insufficient to meet the

situation, and induced immigration from foreign countries to meet the deficiency began as early as 1852. The first immigration was from China. Later it extended to the South Sea islands, Japan, Korea, Manchuria, Norway, Germany, Austria, Italy, Spain, Porto Rico, Portugal and the Portuguese islands off the Atlantic coast of Africa, and the mainland of the United States. Conditions on the mainland are more favorable for field laborers than in Hawaii, and consequently the many efforts to secure laborers from that point have failed. For the same reason there is no likelihood that they will ever succeed.

Asiatic sources of labor supply were near by, and the passage cost low; but at an early date, it was felt that it was good policy to encourage immigration from countries other than Asiatic.

The trip from Europe to the mainland of the United States is short and the fare low, and the expense is borne by the immigrants. The trip to Hawaii is so long and expensive that the immigrants are unable to pay their fares, and the same has been paid partly by the Hawaiian Government, and prior to annexation, partly by the employers needing labor.

The fact that there are no regular steamer lines between Europe and Hawaii has greatly added to the expense of this immigration. All immigration has been by specially chartered steamers, carrying from seven to twelve hundred people, around South America, involving a two months' voyage.

Under these unfavorable conditions, between 1852 and 1913, Hawaii introduced from all sources, approximately 193,000 assisted immigrants, costing over $10,000,000. The last immigrants were 1283 Spaniards, who arrived in Honolulu, June 4, 1913. Including men, women and children, they cost the Territory $117.54 each. The cost of adding each male adult laborer to Hawaii's population was $341.68.

The funds with which to carry on this immigration are obtained by a special income tax on corporations, nearly all of which is paid by the sugar plantations. It is needless to say that this is a heavy tax on the government and sugar industry of Hawaii.

The opening of the Panama Canal will make possible direct steamer service from Europe to Hawaii, at reduced charter rates; resulting eventually, in regular steamer service between the two countries, by which immigrants can come in small parties at lower rates. This will be doubly valuable by increasing the European population and decreasing the cost of getting them.

Whether immigration from Europe continues or not depends almost entirely upon whether a duty is maintained on sugar. If sugar is admitted duty free, there will neither be demand for additional laborers, nor money to pay for them.

The business life of Hawaii can be divided into three periods, viz.:

1. Prior to the execution of the reciprocity treaty between Hawaii and the United States, in 1875;

2. The interval between the passage of the reciprocity treaty and annexation to the United States, in 1898;

3. Since annexation.

The reciprocity treaty admitted sugar, rice and a few other Hawaiian products into the United States, free of duty. Prior thereto, Hawaii had been one of many groups of Pacific Islands doing a trading, barter and supply business with passing ships; chiefly whaling ships, with a small foreign trade. Hawaii was the largest and most prosperous of these groups, differing chiefly in degree, however, from its neighbors.

With the stimulus of a guaranteed free market for its products a remarkable awakening and development took place.

The production of sugar for 1875 was only 12,540 tons.

The total Hawaiian imports were valued at $1,682,000 and the exports at $2,089,000, a total commerce of only $3,772,000 for the year.

In 1898 Hawaii was annexed to the United States. The production of sugar

for that year had increased to 229,414 tons.

Chiefly through the growth of the sugar industry, commerce had so increased that in 1898 the imports amounted to $10,268,000, and the exports to $17,346,000, a total commerce of nearly $28,000,000 for the year.

Although the reciprocity treaty had thus greatly stimulated commerce, the local government was unstable, capital was timid and development retarded.

Immediately after annexation, in 1898, a marvelous expansion and increase of business took place, until in 1912, the foreign commerce of Hawaii amounted to $84,143,000.

The sugar crop for the fiscal year ending September 30, 1914, was 617,038 tons, the record crop.

The exports for the fiscal year ending June 30, 1914, amounted to $41,594,000, and the imports to $36,550,000; making a total exterior commerce of $77,144,000.

The population has increased to 227,391, including 8,373 in the army and navy, and excluding transients.

Hawaii has grown from a population of 56,000; a production of 12,000 tons of sugar and a commerce of $3,771,000, in 1875, to a population of 227,000, a production of 617,000 tons of sugar and a commerce of $77,144,000 in 1914.

Hawaii, by the way, is the only territory acquired at the time of the Spanish War which not only pays all of its own expenses, but is a direct source of profit to the United States government.

Since the organization of Hawaii into a Territory, in 1900, up to June 30, 1914, the United States government has collected in Hawaii, as customs and internal revenue, the sum of $21,320,325. During the same period the expenditures of the federal government for local purposes in Hawaii have amounted to but a small fraction of this amount; leaving a handsome net profit to the United States government.

Practically all of this extraordinary development has been the direct result of the American protective tariff on sugar.

Effect on Hawaii and the Canal of the United States Sugar Tariff.

Under normal conditions the great majority of the sugar plantations in Hawaii cannot make sugar at a profit, without tariff protection.

The demonstration of this statement is too long for this article; but it is available in every detail to any one who wants it.

In a nutshell, the reason for this status is that, excepting on the mainland of the United States, it costs more per ton to produce and market sugar in Hawaii than in any other sugar producing country.

As compared to the great cane sugar producing countries, Cuba and Java, for example, Hawaii is not a natural sugar producing country. It is only by the use of great capital and the development of scientific, intensive agriculture, unequaled on the same scale elsewhere, that with the fostering help of the American tariff, Hawaii has been developed into a sugar producer and now supplies nearly one-sixth of all the sugar consumed by the United States.

This statement will be discredited at first blush, by those unacquainted with the facts, but it will bear thorough analysis.

The main reasons for the high cost of sugar production in Hawaii are as follows:

1. Sugar is not an annual crop in Hawaii.—It takes, with a few exceptions, from eighteen to twenty-four months, and on the higher lands, as many as thirty months to make a crop, instead of a year, as is the case in almost every other sugar country, with the consequent increase of cost; for all expense of upkeep and overhead charges for the longer time must come out of one crop. There are always two crops in the ground, and during several months of the year, three, all under care. The reason for this is climatic—too long to explain in detail.

2. Hawaii is not naturally fertile.—It costs an average of $39 for fertilizer for every acre of sugar cane produced in Hawaii. Other cane producing countries scarcely use fertilizers at all.

3. Irrigation.—With the exception of certain districts, Hawaii is too dry to produce sugar cane without artificial irrigation. The cane from which one half of the sugar output is produced has to be irrigated every week or ten days.

One-third of the employees of irrigated plantations are continuously engaged in watering the cane.

The natural flow of water is insufficient for the purpose, and has to be supplemented by water pumped from wells at sea level to as high as 550 feet.

The irrigation pumps are the largest in the world, and single plantations pump as much as 60,000,000 gallons of water a day.

The fuel used is California oil and Australian coal.

There is more water used per day for irrigating cane in Hawaii, than the daily capacity of the New York aqueduct—700,000,000 gallons.

All this costs immense sums of money which other cane growing countries are not subject to. Cuba does not irrigate at all, and the few others which irrigate use surface, flowing water at nominal expense.

4. Labor.—The labor supply in Hawaii is chronically short, and has to be continuously replenished at enormous cost, as above set forth.

Sixty per cent. of the cost of sugar in Hawaii is for labor; and on sugar plantations in Hawaii, laborers are better and more expensively cared for, and are paid more than in any other cane producing country.

5. Freight.—Under the United States coastwise shipping law, Hawaii is compelled to use high priced American ships only, to carry freight to and from the mainland; while other sugar producing countries can use the cheap freight rates of foreign shipping.

The opening of the Panama Canal has reduced the freight rate on sugar, from Hawaii to New York, from $9.50 to $8.50 per ton, and it may go somewhat lower; but the freight on Cuban sugar to New York, Hawaii's chief competitor, is only $2.50 per ton.

The average cost of marketing a ton of Hawaiian sugar, covering freight, insurance, charges and commissions, is from $10 to $15 per ton. The freight on merchandise from New York to Hawaii ranges from $8 to $20 per ton. The canal has reduced the rate by an average of about ten per cent. Later the reduction may be somewhat increased.

6. Short Term Crops.—Hawaii has to plant cane anew about every third crop. In Cuba they are said to be still harvesting cane growing from cuttings planted by the grandfathers of the present sugar planters. It is common to continue harvesting annually in Cuba from cane planted ten to twenty years before.

There are other minor handicaps to Hawaii's disadvantage, among them that Hawaii is so bedeviled with insect pests, and cane diseases; and the problems of meeting the naturally adverse conditions are so ever pressing and imperative, that the Hawaiian sugar planters are compelled to maintain, at their own expense, an experiment station, demonstration farm and corps of scientists that cost from $80,000 to $160,000 per annum.

The foregoing partially explains why it costs more to produce sugar in Hawaii than in any other sugar producing country in the world, except on the mainland of the United States.

The great world sugar producers, Cuba, Java and the European beet sugar countries, have cheap material, cheap labor and cheap freights.

Hawaii is inside the sacred circle of the American tariff, with its resulting higher basis of cost as to everything which enters into the production of sugar. If it, too, can receive reasonable protection, it can continue, and better its past magnificent record of development; but it cannot buy and produce in a protected market and sell in the open market.

In this respect, Hawaii is in the same boat with the cane sugar industry of Louisiana and the beet sugar producers of the North and West. Although Hawaii has

some advantages over them, they also have advantages over the sugar producer in Hawaii, such as cheaper material, cheaper freights and near-by market.

With reasonable protection, say of one cent per pound of sugar, the United States can, in time, produce all the sugar it consumes, thereby making itself a self-contained country, to that extent.

Without tariff protection, with some exceptions, the sugar producers will be absolutely obliterated both in Hawaii and on the mainland.

It may be replied to the foregoing that they are but generalities, and some "doubting Thomas" may "want to see the figures."

The point is well made, and the figures are herewith furnished:

There are forty-five complete sugar plantations in Hawaii. They are nearly all incorporated and owned by thousands of stockholders. Twenty-four of these are listed on the stock exchange, and their financial affairs are open to all. They are a fair representation of the whole.

The nominal United States tariff on sugar during 1913 was $33.70 per ton; the actual protection was $26.96 per ton, being the duty on Cuban sugar, or twenty per cent. below the full duty. For convenience of calculation call it $27.00 per ton.

Even with this protection, six of these twenty-four plantations failed to make expenses in 1913; two made a profit of less than $2.00 per ton; seven made an average profit of $7.76 per ton; four made an average profit of $12.36 per ton; and three made respectively $15.01, $15.29 and $17.56 per ton.

Under normal conditions the price of sugar in the United States is the world's price, plus the duty.

In other words, the price of Hawaiian sugar in 1913 was approximately $27.00 a ton higher than it would have been if sugar had been duty free.

The present tariff law puts sugar on the free list in 1916. If sugar had been on the free list in 1913, every sugar plantation in Hawaii would have lost money. The proof of this statement is that the above figures show that not a single plantation made as much as $27.00 per ton. The plantation making the best showing would have lost $9.44 per ton, and, as its crop was 50,310 tons, its loss for the year would have been $474,926.00. The one making the poorest showing would have lost $41.44 per ton.

It may be claimed that in 1913 the price of sugar was low. It was. It averaged 3.506 cents per pound. The three previous years averaged higher than for any one of the past twelve years, viz.: the average price of ninety-six degrees raw sugar was 4.188 cents per pound for 1909, 4.453 cents for 1911, and 4.162 cents for 1912. Manifestly the result of a series of years is the only fair criterion of whether the Hawaiian sugar industry can survive free sugar.

The crops and profits of each of twenty-two listed sugar plantations for the eight years 1906–13 are published in the 1914 annual report of the Honolulu stock exchange.

These figures demonstrate that even though three high-priced years are included, there is only one of these plantations which would have paid expenses during the past eight years if sugar had been on the free list, while most of them would have been put entirely out of business.

The details of the results of free trade to these twenty-two plantations are available to any one who wants them.

Some of the plantations named would not fare so badly under free sugar now as they would have during the period named. Economies and improvements in apparatus and methods are being continuously made; but, on the Hawaiian plantations as a whole, the gains are comparatively small; not enough in the aggregate to offset the total loss of tariff protection.

From the foregoing it will be seen that the effect of the Panama Canal upon the commercial life of Hawaii will depend largely upon the tariff policy of the United States concerning sugar; and that, *vice*

versa, the canal will likewise be considerably affected thereby.

If a reasonable protection, say of one cent a pound, is maintained on sugar, Hawaii will send annually between 250,000 and 300,000 tons of sugar east, through the canal, and take in return a proportionate amount of supplies by the same route. If sugar goes, and remains, on the free list, this business will be almost blotted out.

What this would mean to Hawaii cannot be realized by one unacquainted with the conditions. Sugar is the commercial life blood of Hawaii. There are 46,000 persons actually on the pay roll of the Hawaiian sugar plantations, with twice as many more directly dependent on the industry, and almost the entire population indirectly dependent thereon. All the other exports combined in the fiscal year ending June 30, 1914, amounted to only about $6,000,000, with little opportunity for expansion. The civilization and physical existence of the people of Hawaii revolves around and depends upon the prosperity of the sugar business, with no other industry in sight to take its place.

CHAPTER XLVII

THE BRITISH EMPIRE AND THE PANAMA CANAL

GREAT BRITAIN'S ENORMOUS CARRYING TRADE—HOW CANADA WILL BE BENEFITED BY THE CANAL—TRADE ROUTES TO LIVERPOOL REDUCED—BRITISH SHIPPING WILL PROFIT BY AMERICA'S INCREASED FOREIGN COMMERCE—THE SHIP SUBSIDY FACTOR—MILITARY AND NAVAL CONSIDERATIONS.

BY SIR HIRAM S. MAXIM

WILL the opening of the Panama Canal benefit the British empire? Yes, undoubtedly so. The British empire is spread over the whole world and Great Britain has vastly more ships than any other nation. For many years it has practically monopolized the carrying trade, and any new route that is opened to the shipping of the world must prove a great advantage to England and the rest of the British empire.

In studying the probable effects of the opening of the canal to commerce, we should not confine ourselves to things as they exist at the present moment, but should look ahead to the changes that are bound to take place in the immediate future. The United States has a population of 100,000,000, and Canada about 8,000,000. That the canal will be highly beneficial to the eastern states of America goes without saying, as it greatly reduces the distance to the Far East and western coast of South America. The distance from New York to Callao, Peru, by the way of Cape Horn and through the stormy Straits of Magellan is approximately 11,500 miles, while the distance via the Panama Canal will be about 4,000 miles, a saving of 7,500 miles.

Whatever benefits the Atlantic States benefits Canada East in a corresponding degree. Canada has an inexhaustible store of timber, valuable mines, and unlimited water power. She exports timber, pulp, paper, and aluminum; also calcium carbide and silicon carbide; and the Panama Canal will enable her ships to return from South America laden with nitrates, guano, etc.

The population of the United States will, in a relatively short time, amount to 150,000,000, and the population of Canada East will have increased to 20,000 000, without counting the population on the Pacific coast.

Vancouver will also be benefited by the canal, as it will enable her to trade directly with the West India islands and the eastern coast of the two Americas.

Liverpool, which is the greatest seaport in the world after New York, will also be greatly benefited. The distance to Callao, Peru, will be reduced from 11,500 to 6,700 miles, while the distance to Vancouver will be reduced from 16,600 to 9,500 miles; also the distance to San Francisco will be reduced from 15,500 to 9,000 miles. The distance from Halifax, Canada, to Eastern Australia will be reduced from 13,600 to 11,500 miles, and to New Zealand from 13,900 to 10,200 miles.*

It will therefore be seen that the opening of the canal will be quite as beneficial to the British empire as to the United States, which in some respects means nearly half of the world.

The United States produces more petroleum than all the world besides, and as much iron and steel as is produced by any other two nations; she manufactures more printers' paper than the whole world besides; she consumes more than half of the rubber of the world and more than

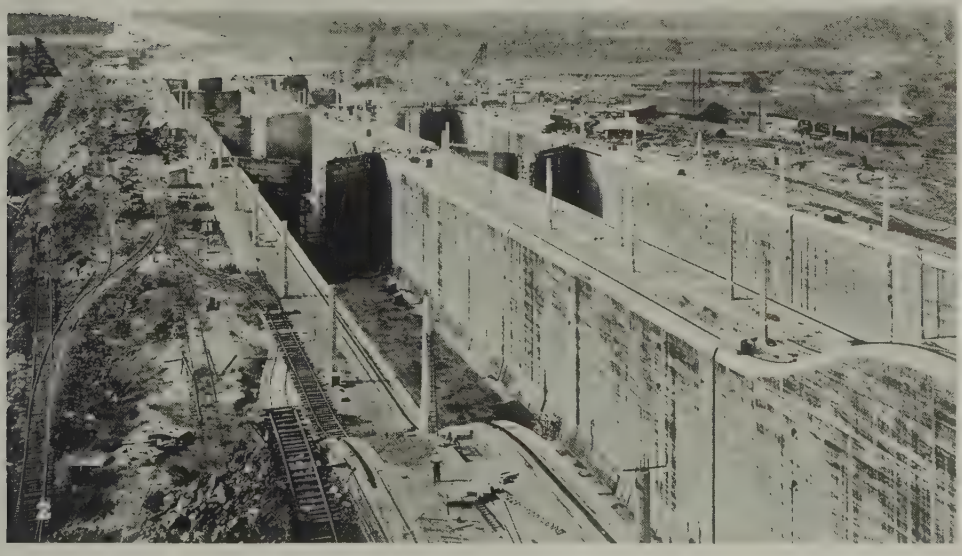
*The measurements which I have given have been obtained from a large globe in my own library.—H. S. M.

half of the coffee, and manufactures more motor cars than the whole of Europe. Three-quarters of mankind throughout the world dress in cotton, and three-quarters of the cotton of the world is raised in the United States. She is the largest producer of wheat in the world and probably raises half of the tobacco. Being a very rich and populous country, there will always be a lively demand in the United States for the products of the East, notably silk and tea; therefore there is sure to be an immense traffic between the Atlantic States and the Far East. And although foreign ships will not be allowed to trade between American ports—for example between New York and San Francisco—still there is nothing to prevent British ships from trading between American ports and the ports of other nations. It is cheaper to build a ship in England than in America, and unless the Americans subsidize their ships very heavily—(an event which is not likely to take place)—there is no reason why England should not monopolize the greater part of the traffic through the Panama Canal.

There are many long and expensive railways crossing the American continent from the east to the west. The railroad interests are very important, and their influence is very great in politics. It is safe to say that they will protect their interests by blocking every effort to subsidize American ships.

I think it is also safe to assert that America, when she decided to execute the greatest and the most expensive engineering feat that the world has ever known, was influenced by something which was not altogether for the benefit of commerce; there was another factor in the equation, and that was to enable her to shift her battleships quickly from one side of the continent to the other. Had no danger loomed up in the Far East, the canal would not have been opened in the early part of the present century.





1. Bird's-eye view of the single flight of locks at Pedro Miguel.
2. View of Gatun Locks, looking toward the Atlantic.

CHAPTER XLVIII

THE DOMINICAN REPUBLIC AND THE PANAMA CANAL

First Land Settled by Europeans—Early Haven for Explorers—Famous Names in History of Santo Domingo—Columbus, Balboa, Cortes, Pizarro, Ponce de Leon—Samaná Bay Key to the Canal—A Natural Sea Haven—Its Attractions—Points of Historic Interest—Plan for Free Harbor—Coaling Station—Trade Opportunities.

By Francisco J. Peynado

FOUR centuries ago, following its discovery by Christopher Columbus, that small portion of this hemisphere now called the Dominican Republic was the first land settled by Europeans, and its capital, Santo Domingo, became the gateway of civilization on the American continent.

Treasured with jealous pride in this historic city are the most precious relics of that most fruitful of all human enterprises—the discovery of America. Here, in the remote beginnings of American civilization, bold conquerors made their haven, and here the missionaries, pioneers in sowing the seeds of progress in every clime, demonstrated their faith, self-denial, and enlightenment.

In the patios and corridors of the palaces at Santo Domingo, built by the first *hidalgos* who crossed the Atlantic, rest the mortal remains of many a bold adventurer and devoted prelate. Here, guarded with veneration, lie the remains of the immortal Genoese sailor. Here crumble the walls of the University, which once gave to Santo Domingo the name of "Athens of America." Here tarried Cortés, Diego de Valazquez, Alvarado, Vasco Nuñez de Balboa, Ponce de Leon, Alonso de Ojeda, Francisco Pizarro, Rodrigo de Bastidas, Valdivia, Oviedo, Las Casas, and a galaxy of others who carried the sword and the cross and the vices and virtues of European civilization to the New World. From Santo Domingo Vasco Nuñez de Balboa sailed on the memorable voyage which immortalized his name and paved the way for de Lesseps and Goethals at the Isthmus of Panama.

When, four centuries later, the dream that began with Balboa's discovery was realized in the completion of the Panama Canal, the Dominican Republic, through a magnificent haven of protected sea known as Samaná Bay, was made the sea's gateway to the canal, giving to the historic republic a renewed influence on the development of trade and commerce.

Samaná Bay is a strip of water thirty miles long and from seven to ten miles wide, protected from wind and sea by the islets which guard its entrance. Mountains surround the bay, and with these heights and the narrow entrance, the port is a natural haven, practically impregnable to storms or hostile attack.

The bay runs from east to west, with its mouth lying towards the island of Porto Rico, at the entrance of La Mona passage. This passage affords the shortest route between the manufacturing centers of Europe and the Panama Canal for the traffic from the Atlantic ocean to the Caribbean Sea.

Samaná Bay can offer to shipping the advantages of a free port, exempt from all duties and taxes, and equipped with warehouses for the storage of merchandise for the supply of ships in transit to or from the canal, and for the needs of neighboring or even distant markets. It can be used for the repairs made necessary to ships during long voyages, and as a base for coal and oil supplies. The bay affords ample

room for the navies of the world, and it is the most convenient and sheltered haven of refuge along the canal traffic lines from the inclemencies of the Atlantic.

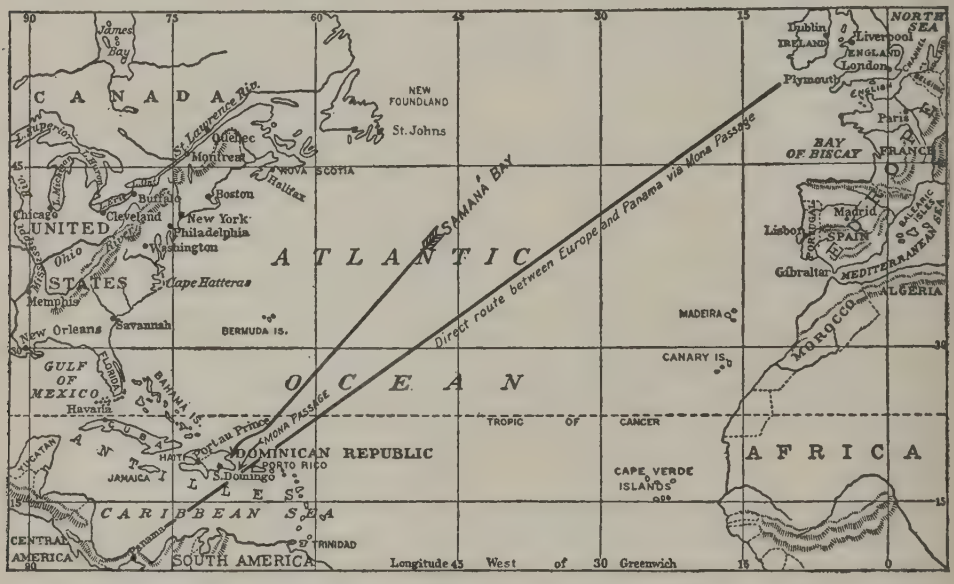
As a winter and pleasure resort, the bay offers unusual attractions. Fish abound in its waters and game on its shores, while its tranquil surface affords aquatic pleasures in the midst of scenery of extraordinary beauty.

At Samaná Bay the tourist finds the scene of the first naval battle between Europeans and Americans. Here the Indians, commanded by Mayabanex, offered the first armed resistance met by the Spaniards in their voyage of discovery in the New World. As the result of this encounter, Columbus named the bay the "Gulf of Arrows."

A few miles to the northwest of the bay are the ruins of Isabela, the first city built by the white man in America. At Isabela occurred the first insurrections among Christians in America. It is notable in the light of later history that the first uprisings in the New World were plotted by full-blooded Europeans.

Near-by, to the south, is the historic town of Boya, which may rightfully be called the cradle of American liberty. It was founded by the famous chief Guarocuya, who brought there the 5,000 Indians left under his leadership after a struggle of thirteen years against the Spanish power, and who finally compelled Emperor Charles V of Spain to sign a treaty of peace granting the abolition of Indian slavery.

The traveler and student will find in this favored section the shores of Najallo, where the Dominican militiamen inflicted a crush-



ing defeat on the strong English expedition led by Admiral Penn and General Venables in Great Britain's effort to wrest the island from the Spanish crown. Here the same courageous militiamen drove off the victors of Marengo, and shattered the plan of the great Napoleon to secure a foothold on the island. On all the island may be found a thousand traces left by the early European discoverers and adventurers who sailed into the New World, bent on missions of peace or on bloody incursions against its inhabitants.

With this history to inspire them, the Dominican generation of the present is

bent upon the equipment of Samaná Bay in keeping with the requirements of modern times. The plan of establishing a coaling station on Samaná Bay is not new. North American capitalists and statesmen have had it in mind, and several times have sought to secure leases on the bay. The Dominican public, however, has been opposed to any plan which would involve alienation or curtailment of its sovereignty, and the republic awaits the realization of the work through the national government or through private auspices under which the interests of the government will be fully protected.

When the French undertook the digging of the Panama Canal, the Dominican government granted a concession on Samaná Bay under which the French would have a free port, with docks, warehouses, and other facilities. The project died with the failure of the French enterprise at Panama, but its revival with the completion of the new waterway across the Isthmus is expected as a natural evolution of the progress of commercial traffic by sea.

To make Samaná the exclusive port for the foreign trade which the growing production in the Dominican Republic insistently demands, it would be but necessary to connect it with the capital and the agricultural portions of the island by a short and inexpensive railroad. At the present time there are two lines of railway and an extensive highway, which afford intercommunication between the principal cities and agricultural centers of the northern part of the republic, and leading to Samaná Bay.

Ships touching at Samaná would then find the following articles for their cargoes:

Cocoa, produced in great quantities in five of the Dominican provinces, and which, under the name of Sanchez cocoa, is exported to Europe and the United States—the Dominican Republic, in spite of its small population, holding the sixth place in the world's output of cocoa; the famous Dominican mahogany, in greatest demand because of its peerless quality; pine, lignum-vitæ and espinillo, and great quantities of other precious woods growing in virgin forests; Barahona coffee, classed among the best in America; cane sugar from plantations whose rich and fertile soil makes resowing unnecessary; tobacco, cotton and honey; meats from the Dominican ranches; and iron and oil from mineral resources as yet untouched

CHAPTER XLIX

BOLIVIA AND THE PANAMA CANAL

SIZE AND RICHES OF BOLIVIA—IMMENSE MINERAL RESOURCES—REDUCED FREIGHT RATES WILL INCREASE BOLIVIAN-AMERICAN COMMERCE—EUROPE'S TRADE WITH BOLIVIA—RAILROAD EXPANSION—POLITICAL ORGANIZATION—IMMIGRATION NEEDED—OPPORTUNITIES FOR CAPITAL.

BY IGNACIO CALDERON
Bolivian Minister to the United States.

NOW that the secular work of dividing the Isthmus of Panama to unite the two great oceans and the whole American Continent has been so admirably and successfully carried through, it seems a proper time to give a glance to the countries to the south and see how they will profit and to what extent they will contribute to the international trade development.

Bolivia is one of the countries of the Western coast of South America offering great possibilities for very profitable and extensive enterprises. Situated in the center of the continent, embracing a territory of over 1,400,000 kilometers, rich in all kinds of minerals, and extending from the high plateaus to the tropical forests of the Amazon vales, it offers every opportunity for profitable mining, agriculture, cattle raising, and the exploitation of tropical products, such as rubber, coffee, cocoa, Peruvian bark, etc.

The central plateau of Bolivia has an area of about 170,000 square kilometers. It is formed by the two great branches of the Andes mountains, which run through the country from north to south and offer a grand panorama of lofty snow-clad peaks, forming as it were, the frame of the great mineral deposits of gold, silver, copper, tin, wolfram, bismuth, and zinc. During the Spanish domination and the first part of the last century, the silver mines of Potosí, Colquichaca, Lipez, and Oruro increased by thousands of millions of dollars the wealth of the world, and if they are not worked now it is on account of the low price of silver compared with the cost of its production.

But tin is at present the most important mineral; its production has grown enormously, and represents almost one-third of the world's output. In 1913 it reached over 40,000 tons; and although the United States uses about fifty per cent. of the world's tin, but eight tons of Bolivian tin came here, the rest going to England, Germany, and France.

The high cost of freight is mainly responsible for such an anomaly, and the Panama Canal will no doubt secure to the United States its due share in this and other Bolivian products.

The mean temperature of the Bolivian high plateau is rather cold, about fifty degrees. The sun, even in winter, feels hot on account of the cloudless sky, but in the shade one is apt to feel chilly. The mean altitude of this section is from 12,000 to 13,000 feet above sea level. The intermediate valleys, where the altitude does not exceed 8,000 feet above sea level, offer a very moderate and enjoyable climate, suitable for corn, wheat, barley and all kinds of fruits of the temperate zone. The great plains and forests on the other side of the eastern cordillera embrace an area of about 800,000 square kilometers, and are watered by a river system navigable by small boats for more than 9,000 kilometers.

Before reaching the great tropical forests there are large grazing fields, where wild cattle roam at will. These will be one of the important centers of the cattle industry. The eastern forests of Bolivia are abundant

in rubber trees, principally the *hebea*, considered the best for quality and productiveness. Amongst the tropical products and fruits, the coffee and cocoa of that section are considered as very superior. Cedar, mahogany, and a large variety of other fine woods add to the value and importance of the forests.

Bolivia is one of the best organized of the Southern republics, and it is a most remarkable fact that the great development that has lately taken place in the various branches of industry, and the peaceful political advance of the country, is owing principally to the efforts and good sense of the native population. On account of its very central and interior position Bolivia lacks immigration and the necessary capital to develop properly the various branches of industry that its extensive and rich territory offers to the immigrants and the capitalists.

In spite of all the drawbacks that hinder its progress, Bolivia has grown very materially in the last few years. Its foreign trade shows the remarkable development of the country. In 1902 it amounted to a little over 42,000,000 bolivianos (the boliviano is about thirty-nine cents gold) and in 1912 reached to over 100,041,000 bolivianos. Germany, England, and the United States furnish most of the imports, but the exports of Bolivia go principally to England, and some to Germany and France. The United States, out of the total exports of more than $35,000,000, received only $29,000 in 1909 and $152,967 in 1912. All this must be changed with the opening of the canal.

Railway construction has been lately very active. Bolivia has now three different railways to the Pacific; one from La Paz to Mollendo in Peru, 857 kilometers; the La Paz-Arica road, 498 kilometers; and the Antofagasta road, that crosses a very important section of the Bolivian high plateau, is 924 kilometers, running from Antofagasta in Chile to La Paz.

Several other interior railroads are being constructed and studied, in order not only to connect the principal cities but to establish an easy communication with the navigable rivers, and thus consolidate the national interests and foster domestic trade.

Bolivia's political organization is based on the principle of the sovereignty of the people, represented in Congress by sixteen senators and seventy-two representatives, elected by direct vote, and a president, first and second vice-president, also elected by direct vote, for four years, without reelection. The judiciary is composed of the Supreme Court, and inferior tribunals appointed for a fixed period.

Public instruction is very much encouraged, and lately many new schools, especially for the Indians, have been opened, and the number of scholars has considerably increased.

The press is represented by over eighty different newspapers and periodicals, published in the principal cities. Public worship is free for all religions, and the foreigners enjoy in Bolivia the same rights as the natives as regards land ownership, mining, and other pursuits. Notwithstanding the fact that Bolivia has no seacoast, having lost it after the war with Chile in 1879, the country has enjoyed a very marked advance, and if it has not grown more rapidly it is owing to the want of capital and population—two main elements of rapid progress.

The total population of Bolivia is not much above two and a half million, of which the majority are Indians; but with all these drawbacks no country in South America has a more stable government, or offers better opportunities.

The Bolivians are sober, hospitable, and industrious; they are a peaceful people, but at the same time there is a pronounced military spirit that makes the Bolivian army one of the best in South America.

With a settled political organization, immense natural resources, a vast and varied territory, a peaceful and industrious people, Bolivia certainly ought to attract the attention of capitalists and immigrants looking for profitable investments, happy homes, and an assured future.

CHAPTER L

THE REPUBLIC OF PANAMA

RAPID PROGRESS OF THE REPUBLIC—REVENUES INCREASED—INDUSTRY DEVELOPED—FINANCES—EDUCATIONAL FACILITIES IMPROVED—TOPOGRAPHY—MINERAL RESOURCES—EXPORTS AND IMPORTS—PANAMA PEARLS—RAILWAY AND RIVER COMMUNICATION—THE GOVERNMENT—THE EXPOSITION—LEADING MEN.

THE causes that determined the separation of Panama from the Republic of Colombia are treated elsewhere, as are, also, the great interests that were factors in that political movement, the result of which was the appearance of the Republic of Panama among the nations and the building of the Isthmian Canal under the flag of the United States.

After Panama became independent, a vigorous transformation in its entire being was commenced. The country strove to place its institutions in harmony with its new status and with its peculiar condition of inseparable relationship to the Panama Canal. The first efforts were directed toward an improvement of health conditions, and to-day the city of Panama is one of the cleanest and healthiest cities in the world.

The barriers that had held back the country's activities and development were overcome, and in a short time commerce had grown, the public revenues had increased, the development of natural resources had been stimulated, and encouraging prospects were opened for the future of the new Republic.

Besides the growth of commerce by sea, industries have greatly developed within the country, particularly those of mining, stock raising and agriculture. Panama now has extensive plants for the manufacture of sugar, and alcohol is produced from material grown in the country. The provinces of the interior find a supply for their own needs in the products of the stock ranches and farms. The construction of roads, bridges, and wharves has greatly facilitated the communication between the towns, and everywhere is felt the impetus of a new era of progress.

A solid basis for financial stability was gained through the placing of $6,000,000 of national capital at good interest under mortgage guarantee in New York, and by the monetary agreement which provides for a fixed value for Panama money in the proportion of two to one for the American dollar.

Panama has also improved in public educational facilities. The National Institute for men, the Normal school for women teachers, the National Conservatory of Music and Elocution, the National Industrial School, and the graduate and primary schools are all thoroughly organized in conformity with modern and scientific methods of teaching. In the first six years of the new régime, schools increased from 187 to 364, with an increase in attendance of 7,000 pupils.

The Panama republic forms the connecting link between Central and South America. It is 32,380 miles in area, with a population of nearly 500,000. Two mountain chains cross its territory, sheltering a number of plains and valleys affording excellent pasturage for cattle, and where grow all the products of the tropics. Extensive forests cover the mountain slopes.

The mountains are a continuation of the great mineral chain running from Alaska through South America, and in them is found gold, silver, aluminum, coal, lead, iron, asbestos, and other minerals. Considerable gold is mined and exported.

Other exports are bananas, rubber, cocoanuts, ivory nuts, cocoabola wood,

sarsaparilla, mother-of-pearl, tortoise shells and hides. The principal imports are textiles, steel and iron manufactures, boots and shoes, rice, wheat, lumber, liquors, mineral waters, and notions.

When the Republic was created but a small part of the area of the country was under cultivation. Since that time, the interest of the government in stimulating agriculture as one of the most stable resources of the country has resulted in a large increase in farming and allied pursuits. The government has steadily promoted interest in the cultivation of coffee, cocoa, cocoanuts, rubber, vanilla, and sugar cane, and has kept these products exempt from taxation. The acreage devoted to the production of bananas, the principal industry of the country, has shown a steady increase.

The making of Panama hats, an industry which in fact originated in Ecuador, has now become an established industry on the Isthmus. The plant from which the hats are made, called *toquilla* in Ecuador, grows wild in many parts of the Panama Isthmus, and the government sent a commissioner to Ecuador to study the process of using it in making the hats. On his return, he brought two experts with him and established a school under their direction in Arriajan. The school was highly successful, and the growth of this industry dates from its establishment.

Panama's pearls have been famous since the advent of Balboa. The main sources of supply are from the Pearl Islands, lying in the Gulf of Panama, about fifty miles from Balboa. These islands have been industriously exploited since 1632, and at the present time fisheries are being worked in a systematic way. The business is carried on under concessions. The beds hold great potential wealth for Panama, and with the systematic planting now inaugurated, will continue to be a valuable asset for the Isthmian Republic.

In 1893, the international railway commission made a survey down the Isthmus of the route for the proposed Pan-American line. Since then the Panama government has authorized the construction of a railway along this route, which will form a short but most important link in the Pan-American system. A number of short lines have been built in various parts of Panama, chiefly in connection with the banana traffic, and these ultimately will be connected so as to give ready intercommunication between all portions of the country. The railroad across the Isthmus between Panama and Colon is forty-eight miles long, with a three-mile branch line to Balboa, the canal's Pacific entrance.

A number of rivers have their sources in the interior of Panama, many of them navigable for small craft except during the heavy tropical rains, which render them turbulent and dangerous. The Tuyra is navigable for small vessels for 100 miles, while the Bayamo, Cocle, Calebebora, Tarire and Los Indios are all navigable for light craft for from twenty to seventy-five miles.

The government of Panama is divided into legislative, executive and judicial branches, under the constitution adopted February 13, 1904. The legislative power rests with the National Assembly, composed of one chamber of deputies. The deputies are elected by direct popular vote for a term of four years. For each deputy a substitute is elected, who takes the place of the principal in the case of his absence, disability, or death.

The president is likewise elected for a four-year term by popular vote. He is aided by a cabinet of five secretaries. Instead of a vice-president, the National Assembly elects three "designados" every two years, eligible to take the place of the president in their respective order in the case of his absence, disability, or death.

The five departments consist of Government and Justice, Foreign Relations, Treasury, Public Instruction, and Promotion, the latter being devoted to the supervision of all matters relating to the promotion of the industries of the country, the means of communication and transportation, and

the maintenance and construction of public works.

The judicial system consists of a supreme court of five judges appointed by the President for a term of four years, a superior court, several circuit courts, and a number of municipal courts. The judges of the superior and circuit courts are appointed by the supreme court, and the municipal judges receive their appointment from the circuit court. All are appointed for four-year terms.

On the formation of the republic the army was disbanded, and a national police corps numbering about 1,000 officers and men was organized. Panama has about 100 post-offices and forty telegraph offices. and has radio stations for wireless communication.

To commemorate the 400th anniversary of Balboa's discovery of the Pacific, Panama had planned an exposition to be opened contemporaneously with the Panama-Pacific International Exposition at San Francisco. The postponement of the naval pageant to July, 1915, led to the postponement of the opening of the exposition on the Isthmus to that month. Panama is also taking an official part in the San Francisco exposition.

The head of the present government of Panama is Dr. Belisario Porras, who attained the presidency after a decisive victory at the polls. At the beginning of his administration he found the finances in feeble condition, and immediately inaugurated a policy of strict economy in governmental expenditure. The result was the extinguishment of the existing deficit, and the accumulation of a surplus to meet the expenses of administration and to supply funds for the improvements which are being made throughout the country. Dr. Porras will leave the presidency with an honorable and meritorious record.

Working with Dr. Porras for a progressive Panama have been Rodolfo Chiari, financier, farmer, and merchant, and first designado, or vice-president; Ramón M. Valdéz, former Minister from Panama at Washington, second designado; Aristides Arjona, jurist and Secretary of Finance, third designado; Dr. Francisco Filós, noted lawyer and jurist, Secretary of Government and Justice; Ernesto T. Lefevre, writer, Secretary of Foreign Affairs; Guillermo Andreve, journalist, Secretary of Public Instruction; Ramón F. Acevedo, financier, Secretary of State; Dr. Eusebio A. Morales, leader in the movement for independence, and Minister of Panama to the United States; Dr. Carlos A. Mendoza, author of the Panama declaration of independence; Federico Boyd, merchant, and former Secretary of Foreign Affairs; Samuel Lewis, financier, and member of the second mixed commission created by the Hay-Varilla treaty; and a number of other prominent men who have stood loyally together for the betterment and progress of the new Republic.

Panama has close financial relations with American financiers, who to a considerable degree have aided in establishing the credit and stability of the young government.

In the latter part of 1902 the International Banking Corporation, of 60 Wall St., New York, considered the advisability of locating a branch of the institution on the Isthmus. As a result of its investigations there was established, first, an agency of the corporation in charge of its own representative, and later, toward the close of 1904 a branch at Panama. For convenience in caring for the operations growing out of the business developed by this branch there was afterward established a sub-branch at Colon, in 1906, and a second sub-branch at Empire, in the latter part of 1908. The Empire branch was maintained principally as an aid in handling the accounts of those employed in the construction of the canal.

This corporation, with total assets of over $40,000,000, has branches in Great Britain and her dependencies, the Philippines, China, Japan, Mexico, the Canal Zone, and the United States, and correspondents in all parts of the world. Its prosperous state has grown steadily under

the régime of H. T. S. Green, its president and general manager.

While the published balance sheet of the corporation shows only its position as a whole, the Isthmian business forms an important feature of its yearly transactions. The establishment of its branches at Panama and its sub-branches at Colon and Empire have been substantial factors in the financial history of the Canal Zone and the surrounding country. The management of its Isthmian branches has been successively entrusted to Messrs. P. G. Eastwick, W. Bundy Cole, F. B. Fearon, and J. Forsyth.

The Panama Banking Company, of New York and Panama, has been and is an important factor in financial and industrial life of Panama. The banking house of Ehrman & Company, of Panama, is also prominent in the affairs of the young Republic.

CHAPTER LI

THE CANAL'S FIRST EFFECTS ON TRADE, PORTS, AND TRANSPORTATION

Traffic Experts Underestimated Movement of Freight—Effects on Transcontinental Railways—Harbor Improvements—Ports Prepare for Increased Shipping—Houston's Ship Channel—Celebrating the Canal's Completion—The Panama-Pacific International Exposition at San Francisco—Canal Tours and Ship Lines—Railroad Outlets to the New Waterway—Tourist Facilities.

LONG before the completion of the canal, traffic experts of the transcontinental railroads as well as the experts of the United States government made elaborate studies of the probable effect of the new inter-oceanic waterway upon transcontinental railway transportation. It was thought the influence of the canal upon trade relations and upon railway traffic had been accurately mapped out, but the canal was open but a short time when it became evident that the experts had greatly underestimated the influence of the new route. The European war broke out two weeks before the canal was opened to commercial traffic. This necessarily to a great extent affected the flow of trade, but despite the check on world exchanges accused by the war, traffic men were surprised at the volume of coastwise freight which flowed through the canal from the beginning.

In the period between August 15 and November 1, 1914, forty-nine ships having a carrying capacity running from 6,000 to 12,000 tons were engaged in the coastwise commerce of the United States through the canal. From as far west as Ohio and Indiana, freight moved in considerable volume by way of New York and the canal to the Pacific Coast. From points equally distant in the interior, freight for the canal passage began to move through Houston, New Orleans, Newport News, Baltimore, and other Atlantic and Gulf ports. As an instance of the conditions, a shipment of 15,000 tons of wrought iron pipe from Youngstown, Ohio, was made via New York and the canal to the Pacific coast. The transcontinental railroad rate for such freight at the time of the shipment was sixty-five cents per cwt., but by way of New York and the canal the rate was forty-eight cents. Canned corn and other products from the Indiana and middle West canneries began to flow to the Pacific by this route in large quantities. From Alabama, heavy commodities such as iron and steel material began to move to the canal route to the West. From points nearer the Atlantic and Gulf ports, great quantities of freight of all kinds began to move toward the canal. The time of passage between New York and San Francisco has averaged about twenty days, which is about that of the average freight movement across the continent by rail.

The railroads enjoyed the benefit of the movement of freight from the interior to the coast ports, but lost the long and desirable all-rail haul of this volume of freight across the continent. To meet the new conditions, Eastern and transcontinental lines have asked the Interstate Commerce Commission to authorize rail rates from the sea competition zone to the Pacific ports low enough to compete with the rates by way of the canal, without, however, reducing rates in the intervening territory.

Pacific Coast Commerce

On the Pacific side, traffic experts declare that the opening of the canal has revolutionized trade and industrial conditions.

The situation which has developed there is summed up in the following analysis by Robert Newton Lynch, vice-president and general manager of the San Francisco Chamber of Commerce:

"The Pacific Coast has as its main harbor San Francisco Bay, which is almost unrivalled among the harbors of the world. This harbor up to the present time has been the goal of great transcontinental railroads, and the whole Pacific Coast has been the natural territory for eastern centers of distribution. It has been impossible to get more than a limited area for local centers of distribution on the Pacific Coast, the adverse natural conditions enabling large eastern manufacturing and jobbing centers completely to dominate the territory.

"The opening of the canal has completely reversed this situation for the Pacific Coast. The low rates which have been announced for tonnage passing through this waterway have upset all previous railroad conditions and dictate the movement of the great majority of products by water instead of by rail. These rates, both east and west bound, are forty per cent. lower *with* tolls than shippers expected they would be *without* tolls. This means that the products of California may be marketed at one-half the previous cost of transportation. The decision of the Supreme Court on the long and short haul case provides that railroads may not meet a terminal water rate without giving the benefit of this low rate to intermediate points, the practical effect of which will be that the railroads must begin to construct their distributive system from the West Coast instead of the East in order profitably to handle the business of the Pacific Coast territory.

"The business man of the west may now take his place on the bay of San Francisco and face the east with the confidence that the whole western territory belongs to the Pacific Coast, and that goods destined from points east of the Rocky Mountains must move by rail to the bay of San Francisco or points on Puget Sound, and be distributed thence by water eastward. The wide effects of this new order may scarcely be realized. It doubtless means that Eastern jobbers and manufacturers must locate branch houses and factories on the Pacific Coast, thus stimulating the immediate development of a great industrial era in the west. It means the encouragement of western capital to take advantage of the new opportunities for expansion with the western coast as a base. It means the stimulation of agricultural industries to meet the broader markets which shipping through the canal affords, and to provide the return cargoes for ships bearing raw material and products for western consumption.

"The canal has thus converted the Pacific Coast from a sparsely settled terminus for trickling lines of transcontinental traffic into a potential field for wide ramifications of commerce and industries radiating from western ports.

"The canal will have an immediate effect upon the population of the Pacific Coast, not merely because it affords a cheaper and more direct route from European centers of of immigration, but for the reason that the inevitable revolution in trade and industrial conditions will demand the presence of great multitudes of people and furnish them with unique and splendid opportunity. The canal would have as profound an effect in bringing as many people to the Pacific Coast, even though it should be prohibited from allowing a single passenger ship to go through its locks, for it will create an economic vacuum in the west which will draw hordes of people from the nearest available centers. Today there are fewer people living west of the Rocky Mountains than in the city of greater New York, but when the effect of the canal has begun to be felt there will be no limit to the increase of population to fill up the vast reaches of the west.

"Even at this early stage a few figures as to freight moving through the canal will prove significantly exegetic of the new conditions which have turned the western

man right about face to the eastern horizon. From the opening of the canal to December 1, 1914, 257 vessels used the canal. By principal routes, and with an indication of the tonnage on which tolls are assessed, this traffic may be summarized as follows:

	Ships	*Tons*
Coastwise, eastbound	54	320,155
Coastwise, westbound	61	282,020
U. S. Pacific Coast to Europe	34	248,020
Europe to U. S. Pacific Coast	8	38,318
South America to U. S. and Europe	24	166,917
U. S. and Europe to South America	15	74,644
U. S. Atlantic Coast to Far East	24	148,207
Miscellaneous routings	7	19,203
Vessels without cargo	30	.....
Total	257	1,297,484

"The exports from San Francisco in September, 1914, through the canal totalled in value $14,467,467, which was the largest month in the history of export business from San Francisco Bay. The entire exports in September of the previous year were $8,662,094. It is confidently expected that both the export and import business to and from European ports through the canal will grow as fast as shipping facilities may be procured.

"It is interesting in this connection to compare the gradual movement of freight from the Atlantic to the Pacific Coast, across the Isthmus of Panama and the Isthmus of Tehuantepec in the six years previous to the opening of the canal. In this period coast to coast tonnage increased 446 per cent. In 1907 the American-Hawaiian Steamship Company inaugurated its coast to coast service via the Isthmus of Tehuantepec. In 1911 the California Atlantic Steamship Company inaugurated a line via Panama. Though the distance from San Francisco to New York by the Isthmus routes is over 2,000 miles longer than by rail, the shipments have steadily increased with the advance of each new steamship line. The value of all goods shipped by both isthmuses in the year ending June 30, 1913, amounted to $131,556,285, of which $87,000,000 was westbound and $34,000,000 eastbound.

"The leading articles so shipped ranked as follows: Westbound—Manufactures of iron and steel, $18,755,779; manufactures of cotton, $11,067,774; manufactures of paper, $6,467,774. Eastbound — Wines, $4,044,320; fruits, $3,708,094; wool, $3,469,217; canned salmon, $2,129,703. The largest eastbound item was sugar from Hawaii to the Delaware Breakwater, amounting to $19,309,351.

"The canal is significant to California and the west because it affords encouragement for the vast Pacific resources which only need cheap transportation to insure immediate development. The Pacific Coast is thus entering upon a new era, wherein her great natural wealth will secure release to circulate in the channels of the world's commerce. New industrial enterprises will spring up, and the Pacific Coast ports will be the beginning of great railroad systems to distribute products to a rapidly increasing population. From the industrial and commercial stronghold thus secured by western merchants, particularly around San Francisco Bay, the Americans of the west will turn their energies to the foreign markets of the Orient, and help to turn the 'Ocean of Mystery' into an ocean of exploited American commerce to meet the expanding needs of Oriental customers."

One of the immediate effects of the canal's completion related to the great fuel oil supply of California, which now produces one-half of the world's petroleum. The California oil fields have at times been embarrassed by over-production, due to their lack of direct tank steamer access to the Atlantic Coast, and European and South American ports. The canal has obviated this difficulty, and California fuel oil is not only moving to supply needs at the canal itself, but is passing beyond into world trade. John Barneson of San Francisco, head of the General Petroleum Company, the Barneson-Hibberd Company and Macondray & Company, was one of the organizers of the movement for a wider field for California fuel oil, and through him and others California's new and use-

ful source of trade and wealth is being pushed into the markets of the world through the canal and over the Atlantic.

In the broader field of world trade, the European war has rendered it impossible to accurately estimate the commercial effect of the canal's opening. The merchant ships of one of the belligerents have been driven from the seas, and many of the ships of other belligerents have been drafted to war uses. It is only when the war has ended, and world commerce has resumed its normal trend that the effect of the new waterway upon international traffic will be developed. It is not improbable, however, that the forecasts of experts as to international traffic through the canal will be found as wide of the mark as were the estimates on the coast to coast trade of the United States, and its effect upon American transcontinental railroads.

Suffice it to say that the canal has brought all New Zealand and Japanese ports and all Australian ports east of Port Lincoln nearer to New York via Panama than to London by the Suez or any other route. Yokohama is now 892 miles nearer New York by water than it is to London, Melbourne 831 miles, Brisbane 2,933 miles, Sydney 1,612 miles, Auckland 3,660 miles, Wellington 3,717 miles, and Dunedin 3,137 miles. The west coast of South America has been brought immeasurably nearer the Atlantic coast of the United States, while the east coast of South America will be within direct sailing touch with the great Pacific Coast region of the American states. Under modern conditions of transportation, the lessening of an ocean voyage by a few hundred miles has a very direct effect in decreasing the cost of transporting merchandise and in stimulating traffic. A modern steamer represents large capital, with heavy daily costs in fuel, labor, food, and other running expenses; and modern traffic on the ocean will follow the shortest routes as surely as the compass needle turns to the Pole. A route saving of from several hundred to several thousand miles from the Orient and Australia to New York appears certain to bring great advantage to American ship owners and American industries as against British and other European ship owners and industries. On the other hand, the west coast of the United States has been brought thousands of miles nearer London and other European ports, and from this, Europe may gain in trade exchanges largely what may be lost to her in other directions.

There is another factor, developing slowly, that will to a marked degree affect the Panama Canal in its relation to international trade. China, the sleeping giant of the Orient, is awakening and is taking up her unlimited capacity for trade and industry. Along modern lines, Japan is rapidly becoming a great commercial nation. The Chinese before long will develop enormously their capacity for manufactures. Some of the raw material will be supplied by the United States, some by Europe, and much by China herself. The exchange of raw material and finished products between China's teeming millions and the Western world will bring a trade, the limits of which can be but dimly estimated, and the ultimate effects of which will be immeasurable upon the development and the destinies of both the Occident and the Orient.

That the shipping interests of the United States are alive to the opportunities offered by the canal's completion is shown by the tonnage of merchant ships under construction just before the opening of the canal. On July 1, 1914, merchant ships were under construction with a total tonnage of 88,510. The majority of these were being built by the Newport News Shipbuilding and Dry Dock Company, of Newport News, Virginia, and the New York Shipbuilding Company, of Camden, New Jersey, two great shipbuilding yards on the Atlantic Coast. Two, with a total tonnage of 12,076, were being constructed by the Union Iron Works at San Francisco, where the opening of the canal has brought a revival of the shipbuilding industry, and

where the Union Iron Works is constructing a great dry dock for naval and merchant ships. For the year ending July 1, 1914, the number of steel merchant ships of 1,000 tons or more completed in the United States was twenty-nine, with a total tonnage of 133,234. Several of the ships were built expressly for the Panama Canal trade, and nearly all will have a direct or indirect part in the new waterway's traffic. The European war, beginning at the opening of the fiscal year 1914–15, will undoubtedly cause a diminished output from American ship yards, but if the war is protracted, increased activity in ship building is anticipated as a result of the traffic lost to other nations and which it is hoped will fall to the lot of American ship building.

Port Improvements

Although the traffic experts underestimated the effect of the canal on American traffic, the port cities of the Atlantic, Pacific, and Gulf sections did not. The governments and commercial organizations of these cities were keenly alive to the importance of the new waterway, and without exception, prepared for an increase in ocean traffic.

Particularly were the Pacific Coast ports thoroughly awake in making adequate provisions for an enlarged trade by improving their harbor and dock facilities. San Francisco, contemporaneously with the opening of the canal expended $9,000,000 in new docks, and at the general election in November, 1914, $10,000,000 additional in bonds was made available for further development of harbor and dock facilities, as the needs require. The port of San Francisco has the great natural advantage of a deep water front surrounding practically the whole city, and all harbor expenditures go into actual wharfage construction without any outlay for breakwaters or dredging. It is noteworthy that of the $600,000,000 expended by the United States government for river and harbor improvements, but $600,000 has been appropriated for San Francisco Bay, and that a large part of this sum was used to blow up a rock which menaced navigation. In contrast, the Federal government has expended approximately $50,000,000 in improving New York harbor, while other ports have absorbed equally huge sums.

At Los Angeles, in preparation for the canal, the city absorbed San Pedro port and made it Los Angeles harbor. With liberal appropriations from the municipality and the assistance of the Federal government, a man-made, land-locked harbor has been created that is one of the most commodious and convenient of its kind in the world. The opening of the canal found the city ready with five miles of wharves, with another mile in construction, and with means for the construction of additional wharves as rapidly as the needs of commerce require them. The harbor is controlled by the city, which has lowered the cost of handling traffic to a minimum.

In the ten years ending June 30, 1912, the commerce of Los Angeles harbor, exclusive of a heavy oil and lumber traffic, increased 2,281 per cent. This astonishing showing opened the eyes of the country to the great possibilities of Los Angeles as a maritime city, and greater strides in sea traffic are expected during the next decade.

San Diego, Santa Barbara, Monterey, Portland, Astoria, Seattle, and other Pacific Coast cities prepared for the canal's opening by improving harbor and dock facilities.

On the Atlantic Coast, the older cities with an already established heavy sea trade were stirred to action, and from Maine to Florida all the ports looked to their docks in preparation for the new waterway. New Orleans and other ports in the Gulf region were similarly alert. One of the Atlantic Coast cities whose development is expected to be radically affected by the canal traffic is Providence, Rhode Island, situated at the head of navigation in Narragansett Bay, with deep water up to the wharves in her inner har-

bor. Providence is also the converging point in her territory for railroad lines which connect with all the great railway systems of the country. For many years the port has been slowly improving the harbor facilities, but more recently this work has been taken up with the fact in mind that Providence is the center of one of the most populous districts of the United States, and that great coastwise and inter-ocean traffic should belong to a city so situated.

Until 1911, the city owned but a small portion of its water front, but in that year the municipality purchased thirty-five acres of land on the west shore of the harbor with a frontage of 3,000 feet. A sea wall to be used as a minicipal wharf was included in this improvement. The construction of additional municipal piers and other landing facilities has been since carried out, and others are in prospect. The thirty-five-acre purchase in 1911 gave the city 177 acres of land available for general port facilities. In anticipation of increased commerce to follow the completion of the canal, the state of Rhode Island in May, 1911, purchased water front property in Providence comprising approximately 748,-523 square feet with a frontage of 700 feet, where piers and docks were built.

With the facilities secured through these and other improvements, the opening of the canal found Providence ready by both land and water to carry on a great foreign commerce. With a long established manufacturing center, and with manufacturing sites of unrivalled excellence along the four rivers which converge at the city, and spacious territory in and around the city for manufacturing plants, the commerce of this Atlantic port is expected to develop as remarkably during the next decade as that of Los Angeles did in the last. The present manufactures of Providence are nearly all such as lend themselves readily to the foreign trade, and in the markets which await the United States in South America and other parts of the world as the result of the European war, Providence may find her stride as a world port.

One of the most enterprising and practical projects for meeting the new trade conditions growing out of the completion of the canal was the construction of the Houston ship channel from Houston, Texas, to the Gulf of Mexico. This channel, fifty miles long, gives the rapidly growing city of Houston a straight course to the ocean, with a safe and commodious passage twenty-five feet deep and 200 feet wide.

The work was completed almost concurrently with the opening of the Panama Canal to commercial traffic in the summer of 1914. The construction was carried out under an appropriation of $2,500,000, paid jointly by the United States government and the Harris County Navigation District, which is practically made up of the city of Houston. The construction was directed by United States engineers.

The United States government will take care of the maintenance of the channel, and for this purpose two large suction dredges have been constructed at a cost of $200,000 each to keep the channel at the regular depth.

Houston, from its foundation in 1836 by General Sam Houston, had access to deep water through the tortuous channels of what was then called Buffalo Bayou. The purpose of the Houston ship channel was to straighten out and deepen this outlet to the sea, and to complete in one comprehensive plan of construction the work of improvement which had been carried out in partial form from time to time in the past. Even under the disadvantages of the old Bayou channel, the outlet has always carried a great tide of commerce, increasing from year to year.

Following up the completion of the ship channel, the city is planning the construction of greater terminals and dock improvements at a cost of about $3,000,000. The plans include the enlargement of the turning basin and a system of docks, a coaling station for ships, and a water system and

power plant for the generation of electricity for lighting and power, both for the terminals and for the factories which will locate in the vicinity of the turning basin. The piers, warehouses, terminals and other shipping facilities will be owned and controlled by the city, and will be available on equal terms to all. No wharfage tax will be charged against ships.

With the stimulus to inter-ocean trade which has followed the opening of the Panama Canal, and Houston's favorable location, a phenomenal growth is predicted for the city and its business as a result of its ship channel enterprise. The present population is estimated at close to 140,000. On account of its situation on deep water, the city enjoys the advantages of deep-water rates, and as a shipping port is 500 miles nearer the granaries of the West than ports on the Atlantic coast, 300 miles nearer than New Orleans, and 570 miles nearer than San Francisco.

Seventeen railroads meet the sea at Houston, all of them having a down-grade haul to the port, a traffic attraction of great advantage. A large share of the products of the central west, seeking an outlet to foreign trade through the Panama Canal and otherwise, is destined to come into Houston, departing through the Houston ship channel.

The annual traffic over the ship channel has already reached the total of $53,000,000. The greatest present item of commerce is cotton, in the handling of which the channel affords a saving to the cotton producers of Texas of over $6,000,000 annually, because of the reduced rate for the fifty miles of water haul.

For the manufacturer, Houston offers a combination of advantages which give a remarkable field for the manufacture and sale of raw materials. A few miles from the city glass sand is found in abundance. To the east and north, there are pine and hardwood forests, rich coal and lignite deposits practically untouched, great fields of fuel oil, and rich iron ore fields which heretofore have not been worked on account of lack of transportation facilities from the deposits to the ports. Back of all these advantages is the state of Texas itself, great in virgin mineral resources, and with vast reaches of land adapted to all uses to which a rich soil can be put.

Already, Houston looms as the manufacturing and industrial center of the south, having 352 factories manufacturing 283 different products, with an approximate value of $53,000,000 a year. These factories employ 11,000 workers, with an approximate pay roll of nearly $11,000,000 a year.

With Texas as the greatest cattle producing state, it speaks well for Houston's transportation and commercial facilities that here is located the largest independent packing plant in the Southwest. This is the plant of the Houston Packing Company, an institution that helps to solve for Houston the high cost of living problems met in less favored cities. In addition to its great stock yards and meat canning factory the company puts up the famous tamale and chili con carne, two food favorites in the West and South, and rapidly becoming known and popular in the East and North. The company's plant is one of the best equipped of its kind, with its own power house, ice plant, lard refinery, cooperage shop and other facilities.

Civic pride is strong in Houston, and under a well-conducted government, good streets, excellent schools and other public facilities are a matter of course. The public and private buildings, the railroad stations, and other institutions are on a par with the fine spirit of a growing, thriving city, proud of its past and confident of its future.

An attractive climate, fine shell roads and boulevards in the suburban reaches of the city, varied and interesting attractions for recreation, including fine hunting, fishing, canoeing and boating facilities, all add to the advantages of the city as a living and business community.

For the tourist and traveler, Houston





MODERN TRAVEL TO THE CANAL AND LATIN-AMERICA

1. Luxurious sleeping quarters on a United Fruit Company Boat.
2. One of the United Fruit Company's Fleet.

offers exceptional attractions. The city is a gay metropolis, provided with every indoor amusement and outdoor enjoyment. Hundreds of miles of perfect motoring roads encircle the city. The picturesque Bayou, with its placid and safe waters, affords boating and fishing every day in the year, and pleasure seekers picnic summer and winter on its grassy, wood-covered banks. The winter months are warm and sunny, with occasional cool weather that brings an invigorating snap to the bracing sea air.

With these advantages, Houston early made provisions for its visitors in the form of good hotel accomodations. There are several first class hotels, and more in the course of construction. Leading the list is the New Rice Hotel, the finest building of its kind in the South, and one of the largest in the country. It was built on the site of the historic old Rice Hotel, at a cost of $3,000,000. It is eighteen stories high, of the most modern and fireproof construction, with equipment and accommodations of the latest high-class design. Standing in a block by itself, with a central court, its rooms are all airy and bright. Car lines radiate from the hotel to all parts of the city and suburbs. The beautiful assembly, dining and other halls of the hotel are the center of much of Houston's social life. The rates and cuisine are in keeping with the city's spirit of enterprise and hospitality.

The Texas gulf coast has been called the American Riviera. Of this favored section, Houston, where soft sea breezes and sunny skies prevail, is a center that is attracting the traveling public in ever greater numbers.

The character of a city's chamber of commerce is often the best index to the city itself. Houston is fortunate in having as a directing factor in its progress one of the most adequate and efficient bodies of this kind in the country. A list of its recent accomplishments would form a model for similar organizations.

Especially active in the chamber of commerce work, and in fostering the ship channel and other improvement projects in the city, is a long list of public spirited citizens. Among these may be named J. W. Scott, vice-president of the First National Bank, one of the strongest banks in the South, housed in a modern office building of its own; Jesse H. Jones, chairman of the Board of the Bankers Trust Company; S. F. Carter, president of the Lumbermen's National Bank, and D. C. Dunn, cashier of the Union National Bank, all leaders in the financial and industrial progress of Houston; M. E. Foster, of the Houston *Chronicle*, the largest newspaper in the Southwest, which in addition to constantly championing the interests of Houston, gave practical demonstration of its confidence in the future of the city through the construction of a modern skyscraper building for the newspaper plant; John H. Kirby, organizer and president of the Kirby Lumber Company, retired lawyer, and the organizer and builder of the Gulf, Beaumont and Texas Railway, afterward sold to the Atchison, Topeka & Santa Fe system; J. C. Hutcheson, lawyer and former representative in Congress; W. C. Munn, under whose presidency of the Chamber of Commerce many important improvement projects were inaugurated and carried out; Sam Streetmen, attorney and former associate justice of the Court of Civil Appeals; Jonathan Lane, lawyer and financier, former member of the Texas State Senate, and president of the Guarantee Life Insurance Company of Houston, president of the American Security and Casualty Company of Houston, vice-president and director of the Continental Trust Company, director of the Union National Bank and the Bankers Trust Company and officer in several other large Houston concerns; H. B. Rice, former mayor of the city, under whose administration many civic betterments were carried out; C. W. Hahl, of the firm of C. W. Hahl & Company, and vice-president of the R. C. Miller Lumber Company, a real estate expert, town builder and devel.

oper of farming communities, who has brought during his twenty-five years' identification with Texas land and investments thousands of settlers to his state, who did most to put the rice industry on a solid base in south Texas, and who maintains a model demonstration farm on land of his own near Houston; O. M. Carter, another realty and land expert, who has done much to attract business and people to Houston; T. H. Stone, attorney and president of the Humble Oil Company; and J. S. Cullinan, G. C. Street, R. S. Sterling, Thomas H. Ball, William A. Wilson, and H. T. MacGregor, all leaders in Houston's financial, commercial, and civic life. Hon. O. B. Colquitt, who attained national fame through his vigorous administration as governor of Texas, has also had an active part in securing national aid for the ship channel project, and in aiding Houston's progress in other ways.

Many cities, rejoicing in the canal's completion, prepared to celebrate the event. New Orleans, which lost to San Francisco the honor of holding the formal international exposition, prepared a carnival celebration of the waterway's completion. The Republic of Panama had planned an exposition to open contemporaneously with the great naval pageant through the canal in February, 1915, but the European war put an end to the pageant plans, and the Panama exposition was postponed until July, 1915, when it was proposed to have the Atlantic fleet of the United States as well as vessels of other neutral nations pass through the canal en route to the San Francisco exposition.

An exposition was opened at San Diego, California, the nearest United States Pacific Coast port to the canal, on January 1, 1915, to continue throughout the year. It is devoted chiefly to fostering better commercial and other relations with the South American republics, and its buildings, remarkably striking in their design, followed the Spanish and Moorish types of architecture.

Panama-Pacific International Exposition

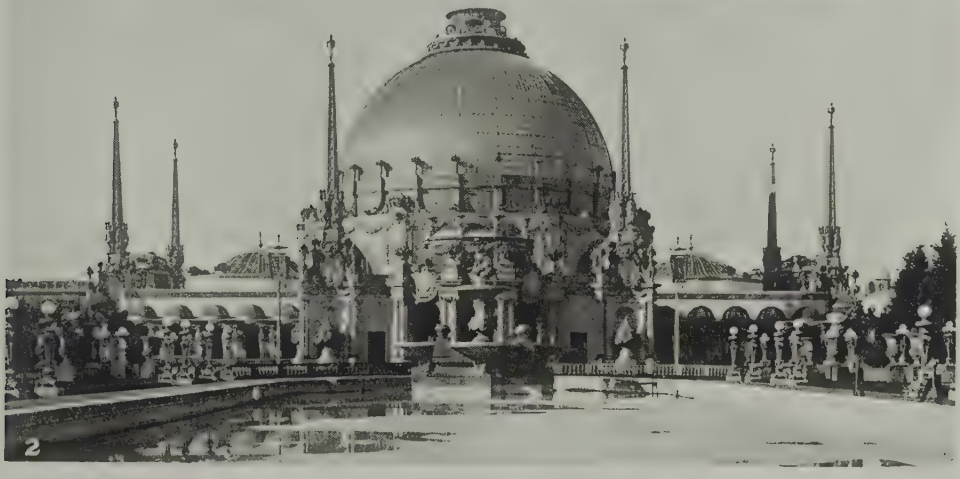
Ready in every detail, free of debt, and with forty-one nations participating, the great Panama-Pacific International Exposition at San Francisco, in celebration of the canal's completion, opened on February 20, 1915, the date scheduled. The pressing of a wireless telegraph button in Washington by President Wilson set the machinery of the exposition in operation. A great concourse of people attended the opening ceremonies at the exposition grounds, all records for opening day attendance at previous expositions being broken.

England, Germany, Russia, and Austria, among the European belligerents, were not officially represented, although numbers of their commercial organizations are participating in the exhibits. France, Japan, and Italy are officially represented, together with forty-one states and territories under the flag of the United States.

The exposition grounds lie in a natural amphitheater along San Francisco Bay, affording the most beautiful setting in which any exposition has been staged. Adjoining the grounds is the large United States military reservation known as the Presidio, facing San Francisco Bay, with the Golden Gate on the west. Under the direction of the world's foremost landscape and building architects, the broad stretches of mural expanse are grained and stained to the texture and color of Italian travertine. Where the statuary has not been wrought from the same material, it has been finished in a soft buff or burnt orange. Thus, with the artistic arrangement of the lawns, palms, and hedges blending with the color tone of the buildings, there has been created a color scheme that will linger long in the memory of the exposition visitors as an impressionistic pastel beautiful beyond description.

Dominating the whole scheme of construction is the colossal Tower of Jewels, 435 feet high, set in the central Court of the Universe, where Corinthian towers





THE PANAMA-PACIFIC EXPOSITION

1. Tree in Fine Arts Palace.
2. Horticultural Palace.

stand taller than those of St. Peter's at Rome. Each column is surmounted by the figure of a star, and from the tower itself 80,000 sparkling jewels of all colors hang, flashing in the sun and scintillating in the lights at night.

The idea of an exposition at San Francisco to celebrate the opening of the canal had its inception in 1904. The great fire of 1906, by which San Francisco was practically destroyed, delayed, but did not stop, the exposition plans. The authorization of the state legislature, together with an appropriation of $5,000,000, was obtained, and in April, 1910, $4,089,000 was raised by subscription in San Francisco in two hours. President Taft signed the exposition act on October 4, 1911. In the work done by the exposition company, by the nations, states, and territories participating, and by concessionaires, an investment of approximately $80,000,000 is represented in the exposition. This far exceeds that of any previous exposition. A $2,000,000 auditorium has been erected as part of San Francisco's new civic center. This building is a permanent structure, and during the exposition will house the 400 or more national and international meetings and congresses which will convene at San Francisco. The exposition will continue throughout the year, ending December 4, 1915. The officers under whom the enterprise grew into its prompt and magnificent completion are the following: Charles C. Moore, president; Frederick J. V. Skiff, director in chief; R. B. Hale, vice-president; William H. Crocker, vice-president; I. W. Hellman, Jr., vice-president; M. H. de Young, vice-president; Leon Sloss, vice-president; James Rolph, Jr., vice-president; A. W. Foster, treasurer; Rudolph J. Taussig, secretary; Joseph M. Cumming, assistant secretary; Rodney S. Durkee, comptroller; Harris D. H. Connick, director of works.

Steamship Connections

The completion of the Panama Canal has awakened in the minds of millions of people in all parts of the globe a desire to stand at the rail of a well-appointed ship and gaze upon the completed task. The railroads and steamship companies anticipated this desire and prepared for its gratification.

The ocean trip to Panama is now probably the most delightful of all those offered to the American public, and can be accomplished with "all the comforts of home," in seven days from New York or Boston or a little less than five from New Orleans. A fleet of modern steamers owned and operated by the United Fruit Company furnishes a regular service from all these ports to the Isthmus and offers, incidentally, many enjoyable side-trips from Colon to the interesting points nearby on the shores of the Caribbean.

The old idea that travel in the tropics means all sorts of discomforts from the torrid heat no longer holds good. Those who have made the trip to the Isthmus on this new type of ship will endorse the statement that the teachings of long experience have enabled the United Fruit Company to build a fleet of some twenty steamers which meet every requirement of the service in which they are employed, and which have been built not only with the view to providing for the pleasure and convenience of the tourist, but—what is more important—with every precaution for his safety.

Life aboard ship in the tropics, to be enjoyed to the full, must be spent in the open air. On the spacious decks room can always be found where the mild breeze adds to the enjoyment of a book or a siesta in a deck chair. The lounge, the music room, with its piano and library, and the smoking-room afford comfort and amusement for those rare hours which must be spent within doors. The staterooms, which are exceptionally large and comfortable, have the best of natural ventilation and are provided with the customary electric fans, but—and in this, these ships are in a class by themselves—they are cooled by a system of artificial ven-

tilation which assures a comfortable night's rest even in the warmest weather.

With a comfortable and enjoyable week's travel aboard ship, and opportunity to see and study the magnificent work of the Panama Canal, and another week of ideal travel with home ahead, there can be no question that the trip to Panama offers more pleasant variety than any other.

The climate of the delightful West Indies region varies little from season to season, and the entire region offers an ideal opportunity for either summer or winter vacation. The tourist may enjoy all the delights of a sea trip and a visit to foreign lands, within the limits of a short vacation. The equable climate of the Caribbean Sea even throughout the summer months will be found cooler than that of many American cities.

The beautiful tropic islands, with their picturesque Spanish cities, and wealth of foliage, are not less attractive than the Mediterranean, and they have the great advantage of being much nearer home. The Panama Canal is proving a great attraction for all Americans. The great engineering feat of its construction is a strong patriotic appeal to the people of the United States. The cruising service of the West Indies has been so carefully organized that it is possible to visit this region without foregoing any of the luxuries of the finest hotels at a very reasonable expense.

Before the outbreak of the European war it was possible to visit the West Indies and the Panama Canal by a series of cruises varying in length from eleven to twenty-five days by the palatial *Prinz* steamers of the Hamburg-American Line. To this service was to be added the large 10,000-ton *Konig* steamers which assure every luxury of ocean travel. All of these vessels have been especially constructed for cruising in the tropics, being large, perfectly ventilated, and equipped with all the newest safety devices, and it is expected that their regular service will be resumed when the war is ended. It will be found very convenient to make a complete cruise of the Caribbean, visiting the Panama Canal and the Spanish Main, using one of these steamers as a hotel at the various ports of call. The steamers made, and doubtless will again make, regular connections with vessels sailing to ports on the West Coast of South America.

During the winter months an additional series of special pleasure cruises were made by the ships of this line to the "American Mediterranean." varying in length from sixteen to twenty-eight days. The special cruising steamer *Victoria Louise*, of the Hamburg-American Line, one of the most palatial steamers afloat, and the S. S. *Moltke*, won great popularity with tourists sailing on these special cruises. Cruising steamers carry no freight, and their schedule is wholly for the pleasure of the tourists. The luxurious public cabins and unusual amount of deck space make it possible to enjoy a series of balls, deck games, and other features which lend added enjoyment and interest to the cruise. It is expected that these cruises will be resumed later by this line.

The accession to the British throne in 1837 of Queen Victoria marked the beginning of an era of busy British steamship enterprise. The Royal Mail Steam Packet Company, which is the oldest steamship company working under a royal charter, was incorporated by royal warrant dated September 26, 1839. Founded to form the "link of empire" between the mother country and the West Indian colonies, the itineraries of the company first included Colon, the Atlantic port of the Isthmus of Panama.

The Pacific Steam Navigation Company, whose charter is dated February 17, 1840, was founded to work concessions obtained from the government of the various Republics on the west coast of South America. Their northern terminal point was Panama, the Pacific port of the Isthmus. Thus from the very beginning these two steamship companies have been intimately connected with the narrow neck

of land which unites the continents of North and South America.

The opening of the year 1846 found the services of the two companies completely established, but with no systematized connection between them. The Royal Mail Steam Packet Company, before the end of 1846, established a regular mode of communication. The organized service of mules and canoes, which it arranged, supplied a badly needed means of conveyance between the two oceans. This speedily resulted in the conclusion of a mail contract in 1847, whereby the British mails were conveyed under contract with the British government outward and homeward by the R. M. S. P. in conjunction with the P. S. N. C. Two years later with the renewal of the original R. M. S. P. contract it was necessary to double the service to Colon. To meet this increase in the number of calls on the Atlantic side, the Pacific Steam Navigation Company augmented its sailings, and in 1852 the establishment of a bi-monthly service between Panama and Valparaiso put it under the necessity of providing additional steamers.

The volume of the traffic utilizing this route across the Isthmus of Panama continually increased, and, during the "gold fever" year of 1848, pioneers in search of the precious metal made use in considerable numbers of the Royal Mail Steam Packet Company's route to California via the Isthmus of Panama.

The Panama Railroad Company, projected in 1850, received substantial pecuniary assistance from the Royal Mail Steam Packet Company, and, after five years had been consumed in overcoming the difficulties incidental to the forty-seven and one-half miles of construction, attained its final completion in 1855. Again the increase in facilities was followed by an increase in traffic. The Royal Mail Steam Packet Company found itself under the necessity of sending trans-Atlantic mail steamers direct to the Isthmus, so as to avoid the transfer at St. Thomas which had hitherto been needful.

From 1868 onward the R. M. S. P. maintained a transatlantic service fortnightly between Southampton and Colon, connecting across the Isthmus with the steamers of the Pacific Steam Navigation Company. In consequence of changes in the mail arrangements to the West Indies during the early part of the twentieth century, the Royal Mail Steam Packet Company in 1905 extended the voyage of its transatlantic steamers tc New York, thus linking the Isthmus not merely with Great Britain, but with the United States.

It will be seen from these facts that these two historic British steamship companies have been associated in the closest manner with trans-isthmian traffic from the very beginning.

The P. S. N. C. was among the first to take advantage of the opening of the Panama Canal with the plan to extend Liverpool-Callao itineraries to Panama and New York, via East coast ports, Straits of Magellan, Valparaiso, Callao, Panama Canal, and Havana. The European war has interrupted the service of this company to some extent but the resumption of its normal traffic will be resumed in due time.

Thirty years ago a line of steamers was established to transport iron ore from the mines in Cuba to the North Altantic ports. Alfred Earnshaw, in coöperation with the Pennsylvania Steel Company and the Bethlehem Iron Company, developed the first successful iron ore mine in Cuba. The product of this mine had to be transported to the United States, and for that purpose Alfred Earnshaw, George E. Earnshaw, both of Philadelphia, and Joseph R. Foard, of Baltimore, established a line of steamers early in 1885.

For a time the steamship business was carried on in the name of Alfred Earnshaw, and later as a limited partnership. In 1892 the business was incorporated under the laws of New Jersey, as the Earn-Line Steamship Company. The first president of the company was Alfred Earnshaw, who held that office until his death in 1896,

when his brother, George E. Earnshaw, was elected and still holds that position, the other officers being H. S. Sharp, vice-president and treasurer, Ambrose B. Umstead, secretary, and W. C. Barratt, assistant-treasurer.

At first the steamers went to Cuba in ballast, but it soon became apparent that this was wasteful and that an outward cargo, even at a low rate of freight, would reduce the cost of carrying the ore. At that time no regular outward cargo was to be had, but by quoting a much lower freight rate than had theretofore been possible, a large coal shipper was induced to reach out after West Indian trade, which at that time was wholly supplied from Wales. This was the beginning of the large export coal trade with the West Indies, and the trade has grown until it has almost wholly driven Welsh coal out of the market. The Earn-Line may, therefore, fairly take credit for being the pioneer in opening this large market to American coal.

During the year 1913 this line carried all the iron ore shipped from Cuba to the United States, amounting to more than a million and quarter tons. During the same period it transported a great part of the coal shipped from Philadelphia, Baltimore, Newport News, and Norfolk to West Indian and Central American ports.

Two lines of steamers were put in operation through the new waterway by W. R. Grace & Company, of New York.

One of these services is through the canal to South American ports, carried on by the Merchants Line, through its high-class steamers *Curaca*, *Chincha*, *Characas*, *Chipana*, *Chimu*, *Coya*, *Capac*, and *Condor*, with a fortnightly service from New York to ports in Colombia, Ecuador, Peru, and Chile. Branches for the sale of American products and the bookings of cargo are maintained by W. R. Grace & Company in all principal cities on the west coast of South America.

The service to the Pacific coast of the United States is carried on by the Atlantic & Pacific Steamship Company, which gives a fortnightly service from New York to ports in California and Washington. W. R. Grace & Company have branches in San Francisco, Los Angeles, Portland, and Seattle, to look after the operations conducted by this service. Among the vessels employed are the *Santa Clara*, *Santa Catalina*, *Santa Cecilia*, and *Santa Cruz*. These are new high-powered 10,000 ton American steamers, especially constructed for the canal trade.

On the Pacific side, the line of steamships of the Pacific Mail Steamship Company were in jeopardy so far as the canal traffic is concerned through the provision of the Panama Canal Act which closes the canal to railroad owned ships. This was remedied by a ruling of the Interstate Commerce Commission on February 13, 1915, under which the Pacific Mail will be permitted to operate ships in the coastwise passenger and commercial traffic to Balboa and intermediate points on the Pacific side of the canal. Through traffic from this line is planned to be transferred by rail to the ships of the American-Hawaiian Line at Colon, connecting with Atlantic ports. The Pacific Mail was brought under the inhibition of the Panama Canal Act because of its control by the Southern Pacific Railroad Company, but the Interstate Commerce Commission held that the steamship line could ply in the coast trade within the limits prescribed without divesting itself of its railroad connection. The palatial service of the Pacific Mail to Honolulu, Manila, Russia, Japan, China, and India continues as usual with the *Korea*, *Siberia*, *Manchuria*, *Mongolia*, and other ships in commission. These ships are among the finest in any interoceanic passenger and commercial service.

Railroad Development

Because the starting point of a circuit tour is usually the terminating point, a trip of this kind might be compared to an endless chain. This viewpoint assumed, the Erie Railroad becomes an important link in the endless chain of a canal tour.

The water route from New York City, through the canal to the Pacific Coast, is one division of the chain. The railroad route from the Pacific Coast to Chicago is a second portion, and the Erie Railroad from Chicago to New York City, the starting point, is a third division.

When the public goes traveling, especially if the trip be one of pleasure, the chosen route must be interesting or disappointment will follow. The cities and towns along the line must have an industrial, historical, or educational appeal. To vividly illustrate the ability of the Erie Railroad to satisfy this laudable desire of the public, a review of the extent of the system, and the parts of the country traversed will be convincing.

Chartered in 1832 by the State of New York for the purpose of constructing a railroad that would connect Lake Erie with tide water on the Hudson River, twenty-six miles north of New York City, the Erie Railroad was hailed as the greatest engineering feat of the time. It gradually pushed its lines west until it now stands among the great railroad systems of America. When the original New York and Erie Railroad was completed in 1851 there was but one other railroad of consequence completed in the world, and singular to say, that one was in Russia, connecting St. Petersburg and Moscow. Thus the completion of the New York and Erie marked one of the first epochs in rail transportation of national importance.

Starting from Jersey City, the main line of the Erie Railroad leads across the northeast corner of New Jersey, paralleling the Pennsylvania-New York boundary line to Jamestown, N. Y. From Jamestown to Chicago the course of the railroad is through western Pennsylvania, Ohio, Indiana, and far enough into Illinois to reach America's second greatest city—Chicago. This section of the United States is rich in historic interest. In New York City, the transatlantic and coastwise docks, and the New York hotel, theater and shopping districts are convenient to the Erie Railroad. In Chicago, good terminal connections with westbound trains are made. Through tickets provide for free transfer of passengers and baggage from the Erie terminal to terminals of westbound lines. Thus the two terminating points of the Erie system link solidly and smoothly with the other divisions of the "circuit tour," and perform their part in making the complete tour pleasant, comfortable, and instructive.

From its earliest days the Erie Railroad has been a pioneer in the adoption of systems and the construction of additions to the line that have resulted in better service to the public. History records that the Erie was the first road to light its coaches with Pintsch compressed gas, the system having been brought to this country from Germany by H. J. Jewett. The idea of a milk train making possible the shipment of good, pure milk from the country into New York City was originated by the Erie Railroad, the idea emanating from President F. D. Underwood. The Erie was the first to establish large tonnage steamers on the Great Lakes. The idea of using telegraphy as an aid in forwarding train orders originated with Charles Minot, of the Erie Railroad, in 1851.

From 1901 over $90,000,000 was expended on the Erie system in lowering grades, completing new tracks, and other improvements in expediting both passenger and freight business. In 1914 the largest locomotive in the world was put into service on the Erie tracks. An idea of its power may be gained from the following details: It has twenty-four driving wheels, eight of which are under the tender. This, the "Centipede" locomotive, is a new style of construction which eliminates the tender as a dead drag. The total weight of this locomotive is 853,050 pounds. The tank has a water capacity of 10,000 gallons, and a coal capacity of sixteen tons. The engine is 105 feet long, and has a capacity of hauling 640 loaded freight cars, the combined weight of which is 90,000,000 pounds, a

train four and three-quarter miles long. Approximately 336 trains arrive or depart from the Erie Jersey City terminal every day. This means a train arriving or leaving every four minutes of a twenty-four hour day. During the morning rush hours, 8:03 A. M. to 9:03 A. M., thirty-seven trains arrive. In the evening rush hours trains leave on the average of one every two minutes.

New England, with the completion of the canal, is standing on the threshold of a new era of commercial expansion and prosperity. Undaunted by competition with other sections of the country more favored in some respects by nature, the people of New England have resolved on securing their full share of the increased trade to come from the opening of the Panama Canal and to establish and to maintain again a commercial empire over the seas such as her old time merchants once enjoyed when they sent New England ships into every port and made their names famous in every commercial capital of the globe.

There has been no decline in New England. Only in her agricultural population has there been a slight falling off, but with this has come a wonderful increase in the population of many of her cities, and in the development of her manufactures, which are now seeking new channels for expansion. And these her people are resolved shall come through the upbuilding of her foreign trade, no matter what it may cost.

Hand in hand with this expansion of her foreign trade is to go the development of her marvelous water power, an almost priceless asset. By the utilization of this "white coal" she expects to further develop the manufactures for which she is renowned. In this effort to secure new trade her railroads will naturally play a leading part. The prosperity of the railroad is inseparably linked with the prosperity of the people it serves.

In the person of Howard Elliott, called from the West to take charge of New England's transportation system, upon which so much depends, the line has at its head not alone a most competent railroad man but a real empire builder, a man to whom the northwest has looked for inspiration and initiative during the last ten years of its remarkable development. Mr. Elliott went West as a young man and learned empire building and railroading at the same time. After being graduated from the Lawrence Scientific School at Harvard as an engineer he became a clerk for the Burlington road, and soon became general freight and passenger agent, and then general manager of the Burlington line. In 1901 he became vice-president of the Burlington, which gave him charge of the maintenance and operation of more than 8,500 miles of line.

It was in this connection that Mr. Elliott made a study of the ways and means of commercial and industrial development. This he continued when called to assume the presidency of the Northern Pacific in 1903.

The railroads upon which New England depends as the arteries of its commercial organization are not large railroads in point of mileage when compared with others of this country, but in many respects they are peculiar, and the operating problems they present are exceedingly complex and difficult of solution. For example, the mileage of the New York, New Haven & Hartford, chief of the New England lines, is only 2,092, yet the New Haven runs more than 2,000 passenger trains daily, to say nothing of its freight trains, and carried in 1913 a total of 86,813,807 passengers paying fare. The peculiarity of the New England railroad is shown still more strikingly by the fact that while two tons of freight are transported to every passenger on the other railroads of the country, considering them as one system, the New Haven transports only one-third of a ton to one passenger.

The enormous passenger traffic of the New England roads, and particularly that of the New Haven, is due naturally to



1. Breakwater at Naos Island, on the Pacific side, looking back toward the land, with Panama city in the right background.
2. Toro Point Breakwater, at the Atlantic entrance, showing stone being dumped from a Lidgerwood train.



1. Rear Admiral Harry Harwood Rousseau, builder of the canal terminals.
2. Sinking concrete caissons for the foundations of the terminals
3. Pacific terminals, with a glimpse of the canal in background.

the density of the population of this region of the country. New England is remarkable in another respect, so far as her people go, and it has a vital bearing on her railroads. Of her total population 83.3 per cent. live in cities and towns. The New Haven's main lines scarcely pass outside of an urban community.

It has been truly said of New England with respect to her railroads that she is but a vast terminal yard. Her railroads are not trunk lines. They deliver to the many manufacturing cities of New England the raw material delivered to the New England lines by their trunk lines. Likewise they collect from the mills and factories the finished products and deliver them in turn to the trunk lines. The freight traffic into New England is much larger in both tons and dollars than that going out. The freight carried by the New England lines consists chiefly of raw materials, imported food stuffs, and manufactured articles. Because of her industrial activity and her lack of raw material it devolves upon the railroads to haul wood, iron, copper, and other materials on which the factories depend.

The New York, New Haven & Hartford taps the greatest manufacturing districts in the United States. Of the fifty largest manufacturing cities the New Haven reaches all but two.

Boston is fortunate in being so situated as to make it possible for her great piers to have direct physical connection with her railroads, and she is also favored as a port in being 200 miles nearer western Europe than any other large American seaport. She is reaching out for the canal trade, determined to claim a share commensurate with her importance and the advantages she can offer in bringing ships alongside of the railroad lines.

The New York, New Haven & Hartford system includes several large steamship lines. These lines run from Fall River, Providence, New Bedford and New London to New York by way of the Sound. A great deal of New England's freight is moved over these lines to and from New York.

The policy of the New Haven and its associated lines is to develop a transportation machine which will be at once efficient and economical, and which will enable the foreign commerce New England hopes to secure to be handled on the most favorable terms and in the most expeditious manner. The opening of the Panama Canal, it is believed, will bring a large increase to ocean traffic to American seaports, of which the New Haven will be one of the beneficiaries.

Another railroad, which, touching water outlets at Washington, Baltimore, Wilmington, Philadelphia, and New York, and reaching far into a rich industrial and agricultural territory, is certain to have a great part in both touring and commercial traffic through the canal, is the historic Baltimore and Ohio line. This line is the pioneer in American railroading and has been first along several lines of transportation development. It was the first railroad in America, the first to obtain a charter, and the only existing railroad bearing without a change its original charter name. The Baltimore and Ohio was the first railroad to utilize locomotive power, the first to penetrate the Allegheny Mountains, to issue a time table and to employ electricity as a motive power. For sea and other traffic, the line has at Baltimore miles of storage tracks and three large grain elevators. It has one of the largest coal piers in the world at Curtis Bay, and extensive ocean terminals and piers at Locust Point.

From the historic point of view the road's route is teeming with interest. It passes through the cities in which the capital of the United States was located at various times, when, compelled to keep up a peripatetic existence, it moved from Philadelphia to Baltimore, then back to Philadelphia, then to Havre-de-Grace, to Annapolis, to New York, and finally to Washington. In the early history of the country, the route now traversed by the Baltimore and Ohio over the mountains

was known as the great "Nemacolin Path," a trail over which thousands of Indians traveled. George Washington as a surveyor laid out a route for a stage road to the Ohio valley over this same trail. Still later, when the French under Pierre Duquesne were usurping British territory in the interior, Washington was sent over this route to warn them to leave. The ill-fated General Braddock, with Washington under him as colonel, traveled this route on the expedition in which the British general met his death. Later the old stage road developed into the National Pike, along which hordes of colonists passed westward.

The first stone of this first railroad of the land was laid July 4, 1828, at Baltimore, the ceremonies being conducted by the Masonic fraternity. The venerable Charles Carroll, last surviving signer of the Declaration of Independence, cast the first spadeful of earth, saying: "I consider this among the most important acts of my life, second only to that of signing the Declaration of Independence, if, indeed, second to that." Thus began America's remarkable railroad development. The line originally extended from Baltimore to Allicott Mills, a distance of fifteen miles, and from thence to Frederick, sixty-one miles. When the track was completed numerous experiments were used for the propelling of cars. Relays of horses were first used, followed by sail cars. When the track was completed and the movement of trains actually begun, the arrival of a train was heralded by the ringing of a bell at the station. In August, 1830, steam was introduced, and Peter Cooper, with his crude engine, hauled the first train. Cooper's was the first locomotive built in America.

Through the Civil War, a large part of the Baltimore and Ohio line was debatable ground, and the route is replete with historic incidents of the great struggle. Harper's Ferry, Philippi, Winchester, Antietam, South Mountain, Maryland Heights, Monocacy, Balls Bluff, Martinsburg, the great field of Gettysburg, and many other historic points are on or adjacent to the Baltimore and Ohio line. One hundred and eight battles were fought on or near the road from 1861 to 1865.

From the scenic viewpoint, the line is equally interesting. Its lines pass through nearly all the important cities from the East to the Mississippi River, ramifying through the great centers of Pennsylvania, Ohio, Indiana, Illinois, West Virginia, and other states to St. Louis and Chicago. From all this great section people and traffic are moving out toward the new waterway at Panama, and over these lines will be distributed much of the world commerce coming into the United States through the canal.

The Southern Railway, called the "premier carrier of the South," offers a short, direct, and comfortable route to the Canal Zone and Central and South America from New York and intermediate and connecting points to New Orleans, and thence by the steamers of the United Fruit Company. This route affords a combination of high grade railroad service with a delightful ocean trip. The system is in the form of a griddle, with the handle running from New York, and with the lines spreading from the handle throughout all the rich Southern and South Atlantic portion of the United States. It reaches the famed winter resorts of Florida, and the mountain summer and winter resorts of North and South Carolina, all the great cotton growing and manufacturing centers of the South, the industrial territory in Alabama and other Southern States, and with its lines pointing south toward the canal, the system is rapidly developing a large share in the canal's touring and commercial traffic.

Another railway, with a sea outlet that began to grow in importance with the completion of the Panama Canal, is the Norfolk and Western railway system, with its port terminal at Norfolk, Va. In a V-shaped loop, this road taps a rich section of the United States, with one end of the loop at Hagerstown, Md., near Pennsyl-

vania's southern border, and the other at Columbus, Ohio. Swinging down toward the South, from the lower part of the loop its lines tap Kentucky, Tennessee and North Carolina, with the main line running straight through the heart of Virginia. From all its lines, direct connections are made north, south, east, and west. The system has done much for the development of Virginia and the other territory through which it passes, and the road will have its share of the inbound and outbound Panama Canal traffic.

With its Atlantic Seaboard terminals located at Newport News, Va., the finest natural harbor on the Atlantic Coast, the Chesapeake and Ohio Railway possesses unequalled facilities for the development of international commerce via the canal. The policy of the company toward development of such commerce is to do everything in its power to foster international traffic movements by giving shippers equal advantage in the way of rates and services with the other points with which it competes.

In addition to the railway facilities, coastwise steamship service between Boston, Providence, New York, Philadelphia, Baltimore, and Newport News is available for transshipment of freight at Newport News for export.

Besides serving Chicago, Louisville, Cincinnati, and Richmond with its own rails, thereby participating in the movement of all classes of traffic and manufacturing to and from those cities and beyond, the Chesapeake and Ohio system traverses the States of Virginia, West Virginia, Kentucky, Ohio, Indiana, and Illinois. Heretofore the leading exports handled over the company's system have gone chiefly to European points, with its import traffic arriving from the same points. With the opening of the Panama Canal, however, and the general stimulus to trade with South and Central America, it is expected that great quantities of exports will move out of the territory covered by this railway system direct for South and Central American countries, while in return the imports from these countries will be distributed in increasing quantities over its line. For export trade, the system connects directly with the territory from which the following exports can be handled cheaply and expeditiously; Bituminous coal and coke; fire clay and fire bricks; stone for building and bridges; iron furnaces; glass; petroleum; railway cars; the products of several paper mills; cement; slate; canned goods; mining machinery; pianos; organs; shoes; tobacco and tanned goods; and forest products. Numerous factories producing these articles are on the line of the railway system. No less than nine iron furnaces are located at various points on the line, and each of the other articles is represented by several factories, some of them the largest of their kind in the world.

On the Pacific side, where railway lines are less numerous, the bulk of the traffic moving to the coast for passage through the canal will pass over the lines of the Southern Pacific, the Western Pacific, the Atchison, Topeka & Santa Fe, and the Northern Pacific and Great Northern systems, the main trunk lines of which reach the Pacific Coast ports. The Gulf Coast has also splendid railway facilities, seventeen railroads entering the one city of Houston, on the Gulf of Mexico. Whether the canal traffic will lead to the building of new trunk lines cannot yet be determined, but it is believed that it will stimulate the construction of numerous short lines, particularly on the Gulf and Pacific coasts.

Tourist Accommodations

In traveling, whether for pleasure or business, hotels form an important consideration. A hotel system which operates in all the great capitals of Europe and in the principal cities in the United States and South America forms an important connecting link for the traveling public. Such a system is the Ritz-Carlton. The principal hotel of the system in the United

States is the Ritz-Carlton, in New York, occupying the entire block on Madison Avenue between Forty-sixth and Forty-seventh streets.

The traveler leaving the Ritz-Carlton in New York, and later entering the Plaza at Buenos Aires, Argentina, finds that he has left nothing of hotel comfort, attention, or completeness of management behind, for he finds in the Plaza everything he had found in the Ritz-Carlton.

Similar claims can likewise be made for excellence of management, completeness of equipment, and quality of service for the other hotels in South America under Ritz-Carlton direction, namely, the Rotisserie Sportsman Hotel at Sao Paulo, Brazil, and the Grand Hotel et Hotel de la Plage at Guaruja (near Santos), Brazil.

As might naturally be expected, there have been developed great hotels in this country, which owe their existence in part to the immense changes in travel and commerce foreshadowed by the Panama Canal.

One of these is the Hotel McAlpin, of New York City. This most up-to-date of all of New York's magnificent homes for the traveling public was planned and constructed with the definite thought of obtaining a large share of the increased hotel patronage that must come from the Central and South American republics to the metropolis of the United States following the completion of the canal.

In the beauty and safety of its construction, the advantages of its location, the efficiency of its management, and the perfection of its appointments for luxury, comfort, and convenience, the Hotel McAlpin represents the last word in its particular field.

It is located at Broadway and Thirty-fourth Street, at the nearest available point to the new Pennsylvania station, and in the heart of the new up-town shopping district.

From the engine rooms of the sub-basement to the topmost floor every practicable idea known to modern hotel management has been made a part of its equipment.

The exterior of the building consists in an application of the Italian Renaissance to the modern type of tall building construction. Its interior appointments comprise the best that modern workmanship can give and art bestow. These are evidenced in its imposing lobbies, its marble columns, its exquisite mural paintings, and its costly tapestry decorations. Among its accessories are gentlemen's and ladies' cafés, lounging rooms, writing rooms, swimming pools, laundry department, and, in fact, every other possible feature conducive to the complete entertainment, pleasure, comfort, and safety of its guests.

The entire structure, containing 1,500 rooms and erected at a cost of $13,000,000, is looked after by 2,000 employees. These are representative of almost every nationality under the sun, so that the sophisticated globe trotter, as well as the fastidious traveler from a foreign clime, may have his wishes, fads, and fancies gratified in whatever style he may choose.

Throughout the whole range of its accommodations, from the main floor to the least expensive guest room in the house, which may be had for $1.50 a day, the principle of maximum efficiency with minimum inconvenience has been applied. As already intimated, the hotel management has had especially in mind the tourist patronage from Central and South American points—a purpose that has already been largely achieved through its having become a chosen gathering point for travelers from those countries.

The Prince George Hotel is one of New York's great hostleries that has always been to the front in anticipating and providing for the comforts and convenience of travelers from all parts of the world, and in anticipation that the canal would encourage an increase in passenger traffic between the whole of Central and South America and the chief port of the United States, this hotel early took steps to meet the demands of that portion of the travel-

ing public that for purposes of business or pleasure will visit us from the countries to the southward.

The central location of the Prince George Hotel admirably adapts it to the needs and convenience of the transient sojourner. It stands at Twenty-eighth Street and Fifth Avenue, half a block from the Subway, and a block and a half from the Sixth Avenue Elevated, in the very center of the shopping district.

The Prince George Hotel contains 800 rooms, each being equipped with every modern convenience. Its dining rooms are of such commodious structure as to seat 500 guests at a time. It maintains an unexcelled service in every particular, and controls its own farm from which are supplied all the poultry and vegetables that are served at its tables.

Among the many stopping places in New York, the Hotel Wellington, at Fifty-fifth and Fifty-sixth streets, on Seventh Avenue, offers attractions and comforts to the traveler from Central and South American countries. Besides being an exceedingly attractive and homelike house, it is admirably located with respect to the various points of interest and amusements. Central Park is only a short distance from the hotel, while the principal shipping district and nearly all of the theatres are within ten minutes' walk.

The Wellington is fireproof throughout, and its appointments are of the first order in every particular. Rooms and suites are specially arranged and adapted to the requirements of families accustomed to every convenience and luxury. The restaurant is conducted on the European plan.

The rates at the Wellington Hotel are moderate, meeting the inclinations of travelers who choose cultured and pleasant surroundings without extravagance in preference to the more garish stopping places.

Situated on East Twenty-ninth Street, in the Madison Square section of New York City, is the first and only hotel for the use of women exclusively, known as the Martha Washington.

This famous and interesting hostelry is a well appointed structure, thoroughly modern, strictly fireproof, and equipped with every facility for the comfort of its guests. It is well known to women travelers from the Canal Zone and South America.

It contains 450 rooms, single and en suite, and is operated on the same plan as any other hotel, with the one exception that men visitors are not permitted above the drawing-room floor.

Being a woman's hotel, women's wit has been used to provide the little necessities and comforts so much appreciated by her. It is here that freedom, yet seclusion, is found. It is here the stranger finds that genial atmosphere which is unusual and therefore appreciated by women who visit New York alone and desire temporary hotel accommodations. Those who have been fortunate enough to have once made its acquaintance invariably return from time to time to enjoy its charm.

With the expected reciprocal travel from the United States to South America following the canal's completion, all the important South American ports made preparations for visitors in the form of hotel accommodations, and the traveler of today will find pleasant quarters at reasonable rates in any of the large cities of a South American tour.

The Pacific Coast is famous for its good hotels. At San Francisco the Palace, St. Francis, Fairmont, and a host of others offer hospitality to the exposition and other visitors. The Alexandria and Van Nuys at Los Angeles, the beautiful Hotel del Monte near Monterey, the Portland and Perkins at Portland, the Savoy and Washington at Seattle, the famous Hotel del Coronado at Coronado, and other fine stopping places in all the Pacific Coast States afford comfort and convenience to the traveler. Even at this modern day in the history of the canal, the tide of travel through the waterway, to and from the United States and South America, will find everywhere comfortable and satisfactory facilities in steamship, railroad, and hotel accommodations.

CHAPTER LII

AMERICAN INDUSTRIES AND THE CANAL

CANAL THE RESULT OF A MULTITUDE OF INDUSTRIAL EFFORTS—AMERICAN MACHINERY, EQUIPMENT, AND INDUSTRIAL GENIUS MET EVERY NEED—HEARTY COÖPERATION WITH CANAL AUTHORITIES—THE "INDUSTRIAL ROLL OF HONOR"—ELECTRICITY ON THE CANAL—EFFICIENT DRILLING MACHINERY—BLASTING OPERATIONS—MILES OF WIRE AND MANILA ROPE—CRUSHING AND DREDGING EQUIPMENT—STEAM SHOVELS—ENGINES—ENORMOUS CONSUMPTION OF CEMENT—GREAT VARIETY OF MECHANICAL AND SCIENTIFIC TOOLS AND INSTRUMENTS—SPECIAL DEVICES—TRANSPORTATION—COMMISSARY—HOUSING—GENERAL EQUIPMENT.

STRONGLY as the Panama Canal appeals to the imagination as the carrying out of an ideal, it is above all things a practical, mechanical, and industrial achievement. The completed work is made up of a multitude of industrial efforts applied to every phase of the actual work of construction, to the machinery used on the canal, and to the health and comfort of the men engaged in the work.

From the gigantic dredges, cranes, and other appliances designed especially for the construction of the canal to the use of bronze instead of iron in delicate machinery to offset the rust conditions of a tropical climate, the practical genius of the American industrial world rose to meet the new and extraordinary conditions under which the work progressed to a triumphant conclusion.

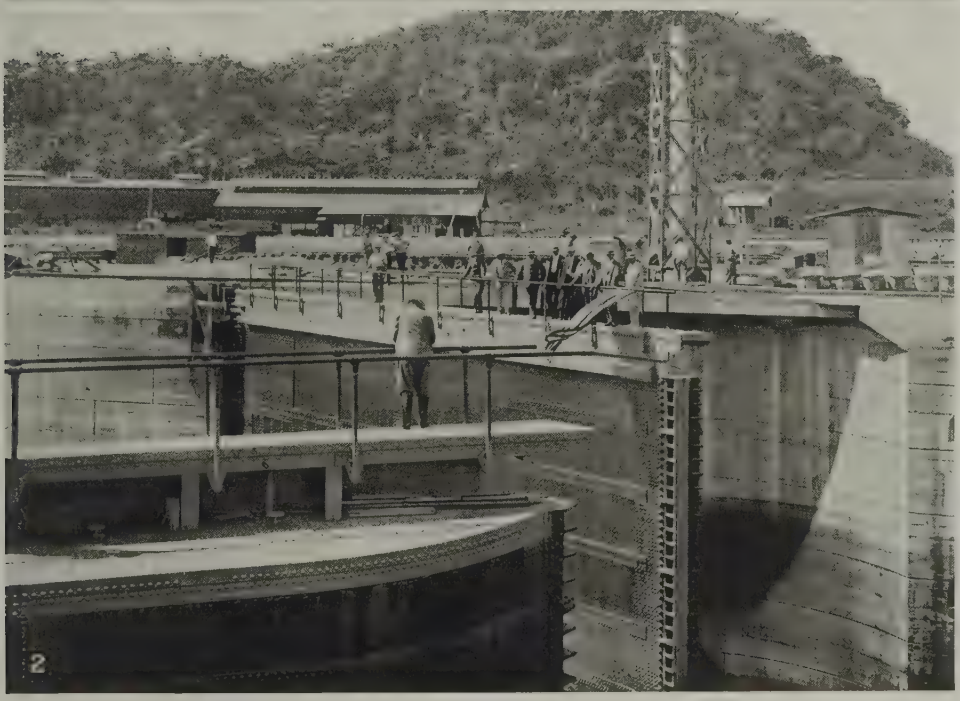
It is a matter of pride to the United States that although the competitive system of bidding was in vogue on the canal, American machinery, American sanitary appliances and American goods of all descriptions were almost without exception found the best and most economical. There was no graft and no waste in the canal work. The products of industry, both of the myriad implements and for the men who labored on the canal, were the best the world could provide.

It may well be that the construction of the Panama Canal will remain for centuries the most stupendous engineering and practical feat of man. For this reason, it was deemed wise to incorporate in this history an outline of the machinery and industrial products and appliances which were used on the canal, not only as a matter of present pride and satisfaction, but because this phase will be of extreme historical value to the student in future years. Even in the short period of time between the cessation of work on the canal by the French and the beginning of the American operations, a remarkable development in machinery and construction equipment had occurred.

The French railways, engines, dredges, hoists, steam shovels and practically all other equipment had become far out of date. The little Belgian locomotives, resurrected from their rust and decay, testified to the good workmanship of their makers by getting into action in the beginning of the American operations, and some of the remaining French machinery was used for a time, but only pending the arrival at the Canal Zone of the more modern equipment which had come into being since the French operations ceased.

In the period following the failure of the de Lesseps plan until the United States began the construction of the canal, the era of steel and machinery development had attained full growth in America. The sky-scraper building had come into being, with its attendant construction machinery. Plentiful supplies of oil and gasoline as fuel





1. Lock gates at Gatun in course of construction.
2. After completion. There are 92 leaves, weighing from 300 to 600 tons each.

had resulted in new types of engines. The great development of American railroads had brought forth heavier engines, and in their path a multitude of machines for excavating, bridge construction, grading, and expeditious shifting or loading of freight. The use of concrete had increased sevenfold, together with the machinery necessary to its use. The giant dredges of the western gold fields, the swamp lands, and the rivers and harbors of the country had been perfected.

When the American engineers came to the building of the canal, all the fruits of this development were ready to aid them. Based on practical experience at home, there was no problem at the canal which American inventive and constructive genius was not ready to solve. If the canal engineers wanted larger machines, the manufacturer was ready to make them. If some types of machinery or equipment staggered under the continuous strain of the canal drive, the manufacturers knew how to strengthen them. They were always ready to fill all requisitions promptly and efficiently. Beyond question, the early completion of the canal is greatly due to the hearty spirit with which American manufacturers coöperated with the desire of the canal builders for speed and efficiency.

Just as the French equipment passed into an obsolete day, so with another turn of Time's wheel, the great engines and machinery which completed the cut from ocean to ocean may take their place on the scrap heap; but at present they embody the high mark of mechanical efficiency in the world, with a record that is well worth the attention of the present generation and that of posterity.

Second only to the roll of honor of the men who had part in the actual construction of the canal is the roll of American industrial concerns which had so great a part in making the labor of the men more healthful, more expeditious, and less arduous. The canal's "Industrial Roll of Honor" is worthy of a high place in the pride which all the world must take in the culmination of the dream of centuries,—the linking of the two oceans by those who work as well as dream.

The various industrial elements which made up the completed canal drop easily into several great divisions. The chief of these are the application of electricity to the completed work and during construction; the efficient drilling machinery which paved the way for the enormous quantity of explosives; the processes of blasting; the part which wire roping played in canal construction; the great steam shovels; the crushing, dredging, and excavating machinery; the sanitary equipment; the enormous consumption of cement; the mechanism of transportation; and the vast amount of miscellaneous equipment which American industry provided.

Electricity in the Construction and Operation of the Canal

In describing the utilization of electric energy in the construction and operation of the Panama Canal, a comprehensive idea of the character of the apparatus provided may be most logically obtained by segregating the references under three general heads:

The first comprises the equipment of the power stations, both steam and hydraulic, in which the necessary energy is generated, and the transmission system by means of which it is distributed to the various working points.

The second includes the motor and control equipment of dredges, cableways, loading and unloading devices, electric locomotive haulage, and the operation of auxiliaries, such as rock crushers, cement mixers, etc., required during the construction period.

The third section deals with the part played by the electric motor in the operation of the lock machinery, the devices designed to insure safety, coördination and positive control of the various sections during the cycle of operations involved in passing a ship through the locks, and the

unique type of haulage locomotives adopted for handling the ships during their transfer to different levels.

In providing electrical equipment for the Canal Zone, it was necessary to consider the special nature of the operating conditions imposed by climate, the imperative demand for continuous service in spite of the apparatus being so far away from the manufacturer of electrical supplies, and the importance of having all parts as nearly "fool proof" as possible. All this entailed a great deal of study and care on the part of the Isthmian Canal Commission engineers in preparing the specifications, and on the part of the manufacturer in building the apparatus to meet these conditions.

The power distribution is composed of:

A 2,200-volt hydro-electric power plant at the Gatun dam spillway.

A steam-electric power plant at Miraflores, erected originally to supply power for construction work, but which will be held for emergency operation.

A double 44,000-volt transmission line across the isthmus, connecting Cristobal and Balboa with the two power plants.

Four 44,000/2,200/240 volt sub-stations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending upon which one of the two plants supplies the power.

Thirty-six 2200/240 volt transmission stations for power, traction, and light at the Gatun, Pedro Miguel, and Miraflores locks.

Three 2200/220/110 volt transformer stations for the index and control boards at the three locks.

Similar stations at Cristobal and Balboa for coal handling plants, machine shops, and dry docks.

The Gatun hydro-electric station is located at the dam of the artificial Gatun Lake, so that the water from the wheels, together with that from the spillways, discharges into the original channel of the Chagres River. The present installation consists of three 2,000 kw., 2,200 volt, 25 cycle, three phase alternators direct connected to 250 r.p.m. vertical reaction-type water-wheels provided with direct connected exciters, as well as two induction motor-driven exciters with a generator voltage regulator. The station plans anticipate the possibility of three additional generators, should the Panama Railroad be electrified and its traffic be increased to require that amount of power. All switches for the control of machines and 2,200 volt feeders are electrically operated (including rheostats, exciters, and field switches) by a storage battery, which also provides emergency lighting for the station through automatic transfer switches in case of failure of the alternating current lighting source.

Current is transmitted at the generator voltage to the principal sub-station, also located at Gatun, through which it passes, after transformation to 44,000 volts, to the main duplicate transmission line running entirely across the isthmus, and interconnecting the various sub-stations.

These two three-phase transmission lines consist of No. 00 copper cables with ground conductors of the same size and material, all supported by steel towers placed on both sides of the re-located Panama Railroad. The duplicate steel towers on each side of the railroad are tied together by skeleton steel bridges, some twenty-four feet above the tracks, from which catenary trolleys may easily be suspended should the railroad be electrified.

The four sub-stations are almost identical in size and equipment, although the number of 2,200 volt feeders is somewhat different. The Cristobal and Balboa stations have only outgoing feeders, as they are distributing stations for power to coal handling plants, dry docks, machine shops, etc., where the current is again transformed from 2,200 volts to the most suitable voltage for the local conditions. The Gatun and Miraflores stations both receive and distribute 2,200 volt current. As already stated, the Gatun sub-station normally feeds the entire transmission system from the hydro-electric plant; and from the



Electrically operated cargo derricks installed by the General Electric Company, of New York, at Balboa Docks.

2,200 volt busses in this sub-station the current for operating the Gatun locks is also distributed. The Miraflores sub-station is similarly arranged in order that it may, under emergency conditions, feed the transmission system from the steam-electric plant, and also supply the current for operating the Miraflores and Pedro Miguel locks.

During the construction period electric energy was supplied by two Curtis steam turbo-generator plants, one at Miraflores, which was later held as a reserve station, and a second at Gatun; each having an output of 4,500 kw.

Steam power was generally used in connection with the hydraulic dredging, although in a number of instances centrifugal suction pumps were driven by electric motors. For the construction of the large dam at Gatun several such pumps were used driven by three-phase induction motors.

The greatest field for electric power application in the construction of the Panama Canal was in connection with the building of the different locks. The amount of concrete required for this work was over five million cubic yards, and it was in the manufacturing and placing of this vast amount that electricity played an important part.

On the Atlantic division the crushed rock was received from the quarries and crushers located at Porto Bello, about twenty miles east of Colon, from whence it was transported by means of barges to the storage point at Gatun. The sand was also transported by means of barges from the sand pits at Nombre de Dios, about fifteen miles beyond Porto Bello. The rock crushing machinery at Porto Bello was operated by steam engines.

The rock and sand were unloaded and stored at Gatun by means of three cableways, two of which were of the duplex type. These cableways were operated by 500 volt direct current motors; separate motors being provided for driving the cableways along the tracks and for the hoisting and conveying drums. All the cement was shipped by boat from New York, and the transfer from the barges to the cement shed was effected by ten electrically operated traveling cranes. From the cement shed and the stock piles the raw material was transported to the concrete mixing plant by a three-phase automatic railway.

The concrete mixing plant at Gatun consisted of eight electrically operated mixers, each having a capacity of about 2½ cubic yards. From this plant the concrete was hauled to the lock sites on a third-rail, 550 volt, direct current industrial railway by means of thirteen 6½-ton locomotives. Four duplicate cableways spanned the site of the locks of this concrete railway and transported the dump-buckets to any required point in the lock structure. The complete operation of the towers was done by direct current motors, and the cable ways were operated continuously day and night, the lighting at night being effected by searchlights.

For the Miraflores and Pedro Miguel locks on the Pacific division the method of construction was different from that at the Gatun locks. The rock was, in this case, obtained close to the lock site, from the Ancon Hill, where a number of electrically operated crushers were located, the crushed rock being carried from the crushers to the mixing plant by means of conveyors. The sand was transported in barges from Chame Point, twenty miles from the west entrance of the canal. At the docks in Balboa it was unloaded by high speed electrically operated cranes, and transported by rail to the storage yards which were located close to the mixing plants.

Several of these electrically operated concrete mixing plants located in the towers of the cranes were provided; the sand and rock being obtained from the storage piles nearby, while the cement was transported from the Atlantic side by rail.

For removing and placing the concrete forms and for laying the concrete, four berm cranes and four chamber cranes were provided, the chamber cranes operating on

tracks in the lock chambers. The berm cranes were used only at Miraflores. They consisted of metal towers, with fixed cantilevers on one side, operating over storage piles parallel to the lock site, and with booms on the other side. The material was transferred to the concrete mixers located in the towers, and the concrete handled by the booms to the side walls, or the batches transferred to the chamber cranes and laid in the central wall.

At Pedro Miguel the berm cranes could not be operated in the same way, and were, therefore, modified, in that fixed cantilevers were provided on either side of the towers.

The mixed concrete was hauled from the mixers on the towers to the lock pit by cars, and thereafter placed in the central and side walls by the chamber cranes. These cranes were all electrically operated, the motors being of the 500 volt, direct current type.

The magnitude of the work involved called for the design and construction of special machinery, and the ease with which motor drive met the most extreme demands in fluctuating loads, and the operation of conveying apparatus carrying unusual weights at unprecedented speeds, constitute a striking example of the flexibility and overall efficiency of electric drive, which became an important factor in securing the excellent operating records which characterized this work.

Electrical Operation

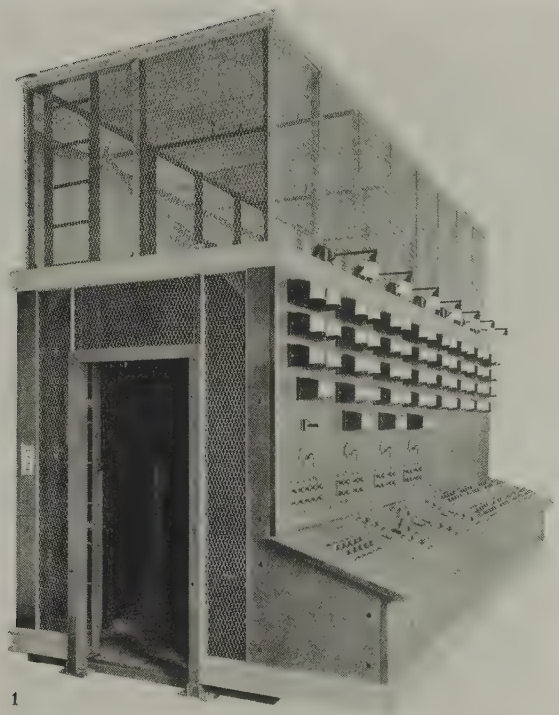
Approximately 1,500 electric motors have been permanently installed for the complete operation of the canal. All of the motors provided for the gates, valves, machinery, dams and cranes are of very substantial construction, being similar to those adopted for heavy duty work in steel rolling mills. They are provided with solenoid brakes and are specially insulated to withstand deterioration due to climatic conditions. The motors are operated on 240 volt, three-phase, 25 cycle circuits.

The rising stem gate valves provided for the main culverts in the side and center walls of the locks, and through which the water from the upper valves will be admitted to the lock chambers, are operated by 116 40 H. P. motors. The upper end of the valve stem is carried by a cross-head actuated by two vertical revolving non-rising screws driven by a reducing gear from a horizontal shaft direct coupled to the driving motor. By means of the solenoid brake the revolving parts may be brought rapidly to rest and, while the machinery is normally operated through a remote control system, auxiliary hand apparatus has been provided for closing the gate in the event of failure of the machinery when it is in the raised position.

At the various locks there are a total of 120 cylindrical valves, each of which is operated by a 7 H. P. motor, the function of these being to control the flow of water from the center wall culvert into the lateral culverts beneath the floor of the lock chamber.

For the operation of the forty-six pairs of lock gates, ninety-two 25 H. P. motors have been provided, one for each gate leaf. In addition to these there are forty-six 7 H. P. motors for operating the miter forcing machines, which force the gate leaves to a perfect junction and lock them in the mitered position. Eighteen 25 H. P. motors are used for operating the guard valve machines which operate the valves that guard the intakes of the side wall culverts at the upper end of each flight of locks.

The hand-rail motors are required to furnish the power for raising and lowering the hand-rails of the footwalk across the tops of the miter gates. These walks provide a passageway for crossing the locks when the gates are closed, and the hand-rail guards the passage. When the gates are opened and in their recess in the lock walls, the hand-rails, if it were allowed, would extend above the level of the top of the lock wall and interfere with the movement of the towing lines. A mechanism was, therefore, devised, and interlocked with the miter gate moving machine, by which the hand-rail is automatically low-



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1. 2200 Volt A. C. instrument and control board for Gatun Hydro Electric Station.
2. Interlocking Rack Lock Control System in Miraflores Locks.
(Installed by the General Electric Company, New York.)

ered when the gate is opened, and raised when the gate is closed. There are 80 motors required for this duty, their rating being 7 H. P.

The chain fenders are operated by means of pumps, and for driving these there are forty-eight motors of 70 H. P. These fender chains are stretched across the lock chambers in front of certain miter gates for the purpose of preventing a ship that might become unmanageable from ramming the gates. The chains are lowered in the floor of the lock chamber whenever it is desired to allow a ship to pass. The mechanism for lifting and lowering the chain consists of a plunger operated by hydraulic pressure, the water for this being furnished by the motor driven pumps.

More than 200 pump motors have been installed. The miter gate sump pumps require ninety-two motors having a rating of 7 H. P. The pump for the drainage sumps at the lower end of each lock utilizes nine motors, also rated at 7 H. P. For the operation of the chain fender sump pumps, forty-eight motors having a capacity of 7 H. P. are used, and for various cable and machinery pits seven motors rated at 7 H. P. To permit the draining of the center wall culverts at intervals, in order to make repairs of the cylindrical valves, there are three semi-portable pumps, one for each lock site. These pumps are of the suspension type and driven by 125 H. P. vertical motors, the pump and the motors being mounted rigidly together.

Six emergency dams have been constructed, two for each of the lock sites. The purpose of these dams is to check the flow of water through the locks, in case of damage, or in case it should be necessary to make repairs, or to do any work in the locks which would necessitate the shutting off of all water from the lake levels. The dams are placed in pairs in the approaches to the upper locks about 200 feet above the upper guard gates, and each can close the approach to one of the twin locks. Each dam will be operated in four movements: the turning and wedging of the dam and the lowering of the wicket girders and the gates. The machinery for these operations is driven by electric motors, but hand capstans have been provided for use in emergency. The turning machinery is installed in the operator's house, and consists of two 150 H. P. motors for turning the bridge and a limit switch to prevent operation beyond an arc of 90 degrees. A 25 H. P. motor operates the wedges which hold the bridge firmly in place when it is at rest across the channel, or on the lock wall. The machine for raising and lowering of each of the six wicket girders of each dam consists of a hoisting drum driven by a 25 H. P. motor, equipped with a limit switch. The gates on the wicket girders are lowered in place with the assistance of gravity, and, when the dam is to be closed, they will be hoisted out of the water. There are, therefore, six gate-hoisting machines for each dam, each machine driven by a 25 H. P. motor.

Each of the gates in the spillways is operated by motor driven machines erected in a tunnel extending the full length of the spillway dam. There are twenty-two of these gates, of which fourteen are located at Gatun and eight at Miraflores. The motors for operating these gates are rated at 7 H. P.

All the motors utilized at the locks are housed in concrete chambers below the surface of the lock walls in order to insure maximum protection, and interruptions to service are guarded against by installing duplicate sets of transformers for supplying current to them.

It might be asked: "Why was electricity chosen to operate the Panama Canal locks? Why not water, steam or air?" This question is answered by saying that only by the use of electricity would it have been possible to control a set of locks from a central point at each flight of locks, and at the same time to arrange the miniature indicating devices in such a way as to be at all times under the control and observation of the attendant. By the use of electricity it was possible to make a combined control

and indicating board, and in no other way could a simple, practicable method of remote operation and indication have been devised, particularly since in some cases the distance between the controlling devices and the operating machinery is greater than 2,700 feet.

The commission engineers specified that the lock control boards should be as nearly as possible an operating miniature of the locks themselves, and so arranged that the indicating devices of the control boards would show the positions of the rising stem and other valves, lock gates, and the water level as it changed in the various locks and in the fore bay. It was also specified that in order to pass a ship through any lock it should be necessary for the control board operator always to manœuver the different operating levers in a definite order corresponding to the predetermined sequence of operation of the lock machinery necessary to pass the ship quickly and safely through, and that the operator in control of the eastbound channel of the canal must not in any way be able to interfere with the apparatus under the jurisdiction of the operator controlling the westbound channel. The imposed conditions have been fully cared for. Each lock control board indicates to its operator the actual position of the level of the water and of the lock machinery at any instant. Also, by a system of horizontal and vertical interlocking bars beneath the control board, the control handles are so interlocked that only the proper handle or handles can be operated at any time in the course of a ship's travel through the locks.

The interlocking system forces the attendant to operate the chain fenders, gates and valves always in the proper sequence, and also prevents him from operating these devices in incorrect sequence; for instance, opening the gate when the chain fender is not in position or when the valves are open, etc. There is also an interlocking combination that is used in connection with the intermediate gates which divide the locks into short sections. This arrangement is fitted with Yale lock and key so that the intermediate gates can be used only when the attendant has unlocked the combination, this also being subject to the general interlocking system. Certain valves are used to cross-fill between locks. These also are interlocked so that they can be operated only in proper order and combination to equalize the water between a pair of locks and save water which would otherwise be wasted. This cross-filling consists in allowing water from one lock, which is full, to flow into a lock by its side in the other channel until the level of the water is the same in both locks, thus using a portion of the water over again.

The fact that the control board is a working miniature of the lock which it operates shows the operator the actual condition of gates, height of water, etc., and, consequently, having the whole situation in miniature under his eye he knows what to do next and when to do it; the operator receiving his information as to the movement of the ship from a towing master. The engineers on the locomotives which take the ships through the locks, as well as the towing master, can see the position of the gates, but the position of the fender chains is indicated by semaphore arms on the lock walls.

As ships are not permitted to enter the locks or go through on their own power, a special type of towing locomotive has been designed for handling them during transit from one level to another. This constitutes a unique feature of the electrical equipment of the canal. There are forty of these towing locomotives, each weighing 86,000 pounds, and having an available tractive effort of 47,500 pounds. Mounted in the center of the locomotive body is a windlass having a rope pull of 25,000 pounds. Ordinarily, four of these locomotives will be used to haul ships into and through the locks, two of them on each side, running on tracks parallel to the locks, and obtaining their tractive effort by means of two 75 H. P. totally enclosed

motors of the mill type for each locomotive, one motor being direct connected through reduction gearing to the axle. Current is supplied by means of contact plows, and the locomotive is propelled on a rack-rail while towing, and while going up or down the steep grades between levels. The towing speed is approximately two miles per hour, and while running idle on the return tracks the rack pinion is released and the locomotive is propelled by the regular traction at a speed of five miles per hour, the change from one system of propulsion to the other being effected through gearing by manually operated clutches. The two locomotives astern of the ship act simply as a brake on the ship's movement, the forward locomotives doing the towing.

The windlass cable is operated by two 20 H. P. motors, which are totally enclosed, and the cable drum is driven by a friction device which can be set at any desired value—from zero to the full capacity of the motor.

For the supply of coal to naval and merchant ships two coal depots will be provided, located respectively at Cristobal and Balboa. In general, each plant will consist of two water fronts and a storage pile, the water fronts being designated as unloading and reloading wharfs, while the storage pile will consist of a basin for coal, a part of which is to be stored subaqueously, and the remainder piled above it in the dry. The total capacity of the plant at Cristobal will be 300,000 tons, and for Balboa 210,000 tons.

The equipment of the plants will be similar in general construction, and consist of unloading towers, which are self-contained and self-propelled, stocking and reclaiming bridges and reloaders. For the transportation of the coal within the plant a separate conveying system will be arranged. Each reloader will travel on rails laid at the elevation of the decks at the reloading wharves, and will have a normal capacity of 500 tons per hour.

The operation of the entire equipment, excepting the unloading towers, will be electrical, with suitable sub-stations erected at each plant, and steam power will be used only for the operation of the unloading towers.

In addition to the power applications, electricity is used extensively for lighting purposes as well as for such auxiliary service as the operation of the telegraph system, fire alarm, and mining batteries for the defense of the canal. In order that the fortifications may be independent of the main source of electrical supply, they have been provided with small isolated plants equipped with gasolene-electric generating sets.

It is evident that from the foregoing that electricity has played an important part in the construction work involved in this, the largest engineering feat of the ages, and that it is a vital factor in the operation of the completed work, and renders possible in this capacity operating efficiencies not otherwise obtainable.

The success with which the electrical apparatus on the isthmus has met all operating demands serves as an indication of the ability of the designing engineers who were responsible for the detail work, and the possession by the electrical manufacturers of an equipment adequate to meet all the unusual requirements imposed by the remote location and adverse climatic conditions of the Canal Zone.

In this important sphere of the canal equipment, the General Electric Company of Schenectady, N. Y., maintained a dominant position, inasmuch as its factories produced more than one-half of the electrical apparatus used during the construction period, and practically the entire equipment for the generation, distribution and application of electric energy for the permanent operation of the canal proper, the coaling stations at both terminals, machine shops and other auxiliaries.

The Rock Drill on The Panama Canal

More than 200,000,000 cubic yards of material have been excavated from the prism of the Panama Canal. Of this great

mass, about one-half is classified as rock. All of this rock was drilled and blasted.

An approximation shows that for each cubic yard blasted an average of six inches of blast hole was bored in which to place the explosive required to break the rock. The depths of the holes bored, on this basis, for blasting 100,000,000 cubic yards, would give 50,000,000 lineal feet as the combined depths of all holes drilled. This aggregate of the boring would be of a length sufficient to form a continuous bore more than 1,500 miles longer than would be required to penetrate the earth's diameter from the North to the South Pole. The quantity of material or detritus displaced by the drill bits in forming holes would equal the volume of rock removed in the construction of a railroad tunnel more than three miles long, and of the cross section of the Simplon tunnel in the Alps.

A cumulation of the whole quantity of detritus displaced by all the drills in forming blast holes would, in extent of volume, equal the Pyramid of Menkaura at Ghizeh.

These general approximations afford comparative illustrations that will aid in an appreciation of the essential functions of the rock drill in the excavation of rock, the amount of work performed by the collective operation of drills, and the paramount importance of the work of the rock drill as the prerequisite to the displacement and removal of the vast masses of rock that have been excavated from the quarries and from the prism of the Panama Canal.

Three general types of rock drilling machines were in service on the canal works,—the diamond or core drill, the well or drop drill, and the percussion drill.

The diamond or core drill was used in the determination of the nature, qualities, and depths of the strata on the line of the canal, and the relative quantities of each formation that would be encountered in the creation of the canal. The salient characteristic of the diamond drill is a capability of cutting out a continuous core to the depth of penetration of the substance being bored. This core is a cylindrical section of all the formations penetrated and provides samples of the strata in their natural form. This data on the thickness and qualities of the different formations penetrated, taken from a great number of borings, form a basis for estimating the relative quantities of each formation. This cutting, or more properly abrading, process, by which the core is formed, consists in the rotation of a hollow tool or tube, the end of which is in contact with and pressed against the material being bored. This end is either in the form of a hard steel tubular tool with cutting teeth, of an annular piece of metal with diamonds or bort inserted in the cutting face, or steel shot or other hard substances are supplied to the underface of a plain tubular section where the revolution of the tool under pressure causes a grinding or abrasive action of the hard shot on the rock. The end of the drill or crown in contact with the rock is a separate piece detachable from the main tube of the drill. The rotation of the cutting or grinding surface cuts out an annular section, leaving a solid cylindrical central core which is undisturbed and enters the tube or core barrel as the drill penetrates the rock. This tube is rotated through gearing by an engine, or, in smaller machines, by hand. Water is fed through the tube to remove or wash out the detritus or ground particles. The diamond drill will bore holes to great depths,—a vertical penetration of 7,000 feet has been attained. The mechanical principle and the process of cutting, of this type of drill, has been known and used for cutting stone and boring holes from time immemorial. Stone was cut by bronze saws having jewels inserted on their cutting edges, and drilling was performed by the rotating of copper tubes supplied at their cutting ends with corundum, in the building of the Egyptian Pyramids. These tools were known to be in common use in 4700 B. C. The rotary rock drills now in use are the reinvention of their ancient prototypes, with the application of power in their operation.

The well or drop drills were quite generally used on sections of the canal works where the class of work and nature of the formation were favorable to their employment, and where vertical blast holes of large diameter were required. The well drill is restricted, owing to its action being dependent on gravity, to the cutting of vertical holes. The merits of this type of drilling apparatus are the simplicity of its operation and its adaptability to work in formations overlaid with earth. The holes drilled by this type of machine are usually from five inches to eight inches in diameter.

Blast holes of large diameter permit the use and concentration of heavy charges of slow acting explosive. A slow explosive in heavy charges, when detonated, produces a large volume of gas, and is found most effective in disintegrating the softer strata, friable rock, or loose earth and indurated clay.

The simplicity of the action of the well drill is of great advantage where, as on the isthmus, expert operators were not always available for a more complicated mechanism.

Generally stated, the process of operation of a well drill consists in the raising and dropping of a bar by means of a cable or rod. This bar is formed as a bit or cutting tool on the lower end. The measure of the work performed is dependent upon the weight of the bar and the kinetic energy developed by the attraction of gravity on impact with the rock. The speed at which the bar may be raised is restricted by its inertia, as affecting the cable connections, to about sixty blows a minute.

The drop or well drill is used throughout the world for deep borings. In different countries various modifications in design are adapted. To illustrate: In the United States a hemp cable is almost invariably used for operating the bit; in Canada and Russia, jointed wooden rods replace the cable. In Europe, the use of metal rods is the general practice; wire cable is sometimes used, or a combination of the various systems. The fundamental system of operating is the same, though there are many mechanical differences and modifications.

In drilling, the cable, carrying the drill bit, is suspended from a "walking beam" or lever usually oscillated by an engine. For blast holes or spudding there are differing designs of feed and cable mechanism.

A device called the "temper screw" regulates the feed. The operator rotates the cable at each stroke. This ensures a straight hole and prevents the cutting edge of the bit from striking in the same place as in the preceding blow.

On the Panama Canal work the "oil well system," or rig, was used. The rig is mounted on wheels adapted to run on the ground; the engines, drums, and derrick supporting the working beam are carried by and are an integral part of this wagon. The operating cable carries its so-called "string of tools" which, in the simplest form, consists of the drill or bit, the jars, and rope socket. The jars are a pair of sliding links which on the up-stroke as they come together produce a sharp shock or hammering effect that tends to jar out the bar if binding in the hole. Drills of this type, mounted on wheels, are, where the conditions and formations are suitable, used for blast holes of large diameter or holes of no great depth. Where holes of great depth are to be bored, a permanent and stable frame or derrick is erected over the site of the hole. The oil derrick, as it is called, consists generally of four uprights or legs held in position by ties and braces, the whole resting on strong wooden sills. This structure is usually about seventy feet high, twenty feet across the base, and four feet across the top. The whole derrick is set up with keys and may readily be taken down and erected on a new site. Samson posts for supporting the walking beams are dovetailed and keyed into the sills. For blast holes the drilling usually varies anywhere from fifteen to fifty feet in depth, but in exceptional cases, they are much deeper.

The origin of the well drill is not known; in very early times it was in use in China, the operating power being men, horses or oxen. In Europe, this mode of boring for water was first practiced in the French Provinces of Artois, whence the name Artesian is derived; wells dating from the 12th century are still flowing. Unmistakable evidence of much more ancient bored springs appears in Lombardy, in Asia Minor, Persia, China, Egypt, Algeria, and in the Great Desert of Sahara.

The economic trend towards increase of performance through the application of power to greater speed of operation, to increased flexibility and adaptation to varying conditions, to lightness and portability and consequent ease in handling and in operating, was met by the invention of the modern percussion type of drill about the middle of the 19th century.

The percussion drill is an American invention, the first practical patents having been taken out in 1849, by J. J. Couch of Philadelphia. In Europe the nearest approach to rock drill invention was the German work of Schumann in 1854. Following these came the inventions and developments of Haupt, De Volsen, Wood, Simon Ingersoll, Sergeant, Waring and Githens, with the invention of the Rand drill in 1871.

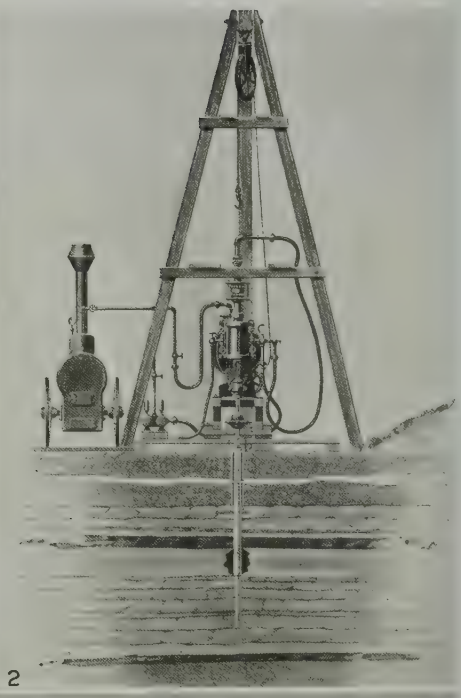
Power operated percussion drills may be divided into two general classes, distinguished by their characteristic action. Of these two classes the first form is where the drill steel is attached to and forms an extension of the piston rod of the drilling machine and reciprocates with it. This form is shown in the inventions of Ingersoll, Sergeant and Githens. The other class is the "hammer" type where the drill bit is not reciprocated but performs the boring through the effect of the hammering action of the drill piston or hammer on the shank or upper end of the drill steel as the steel is slowly rotated. The Leyner drill is typical of this class.

The reciprocal movement of the piston, in either general class, is controlled by one of three distinctive forms of valve action: the steam or air thrown valve, as exemplified in the Ingersoll type; the valve actuated through mechanical connection, as by tappets, levers, or poppets controlled by the movement of the drill piston, as in the invention of Githens; the action of the third form of valve combines the actuating principles of both preceding types. A small tappet or arc is controlled in its movements by the piston of the drill. This small arc forms an auxiliary valve which controls the movement of the main valve by uncovering small ports and subjecting the pistons on either end of the main valve alternately to air or steam pressure and relief from pressure. This design is illustrated in the inventions of Sergeant.

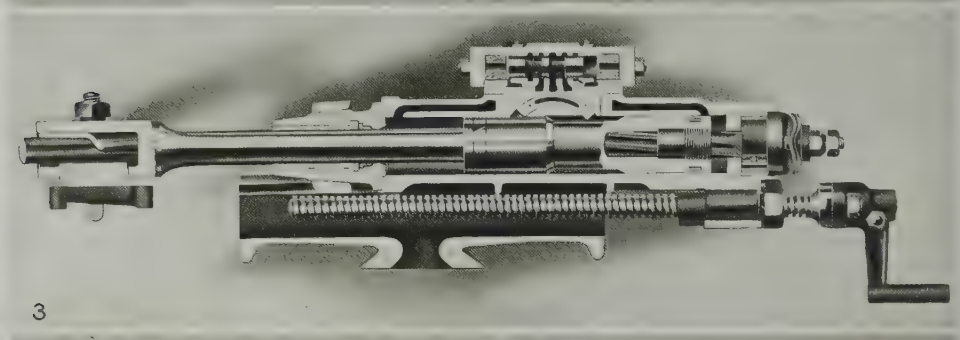
To make a true straight hole and to prevent the drill bit from repeatedly striking one place, a rotating device, called the "rifle or rotation bar," forms a working part of the percussion tripod drill and of some forms of the smaller hammer drill. This rotating gear consists of a bar having rifled or spiral grooves running the direction of its length, and having a pitch or spiral path of about one-third of a complete revolution in the length of the piston stroke. The spiral bar is integral with a ratchet gear, or other similar device, and is supported in a bearing and encased in the upper head of the steam cylinder. The long piston drill is bored to permit free sliding or reciprocation over this bar; the upper end of the piston is fitted with a fixed nut whose inner face conforms to the spiral grooves of the bar. The pawl and ratchet device permits rotation in but one direction; the consequent action on reciprocation of the piston is that on one stroke the rifle bar being prevented by the pawl from turning, the drill piston carrying the drill bar turns through the part of a revolution corresponding to the spiral of the rifle bar. On the reverse stroke of the piston no rotative action, other than that due to inertia, is exerted, as the rifle bar is free to turn in the reverse direction. In the best practice the rotating bar will release or



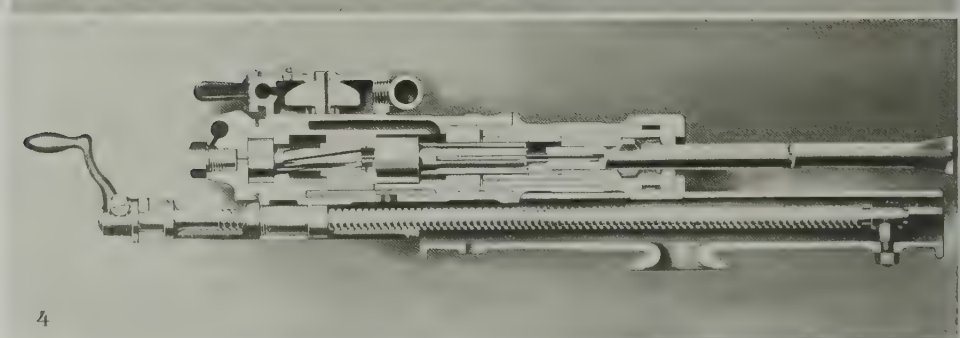
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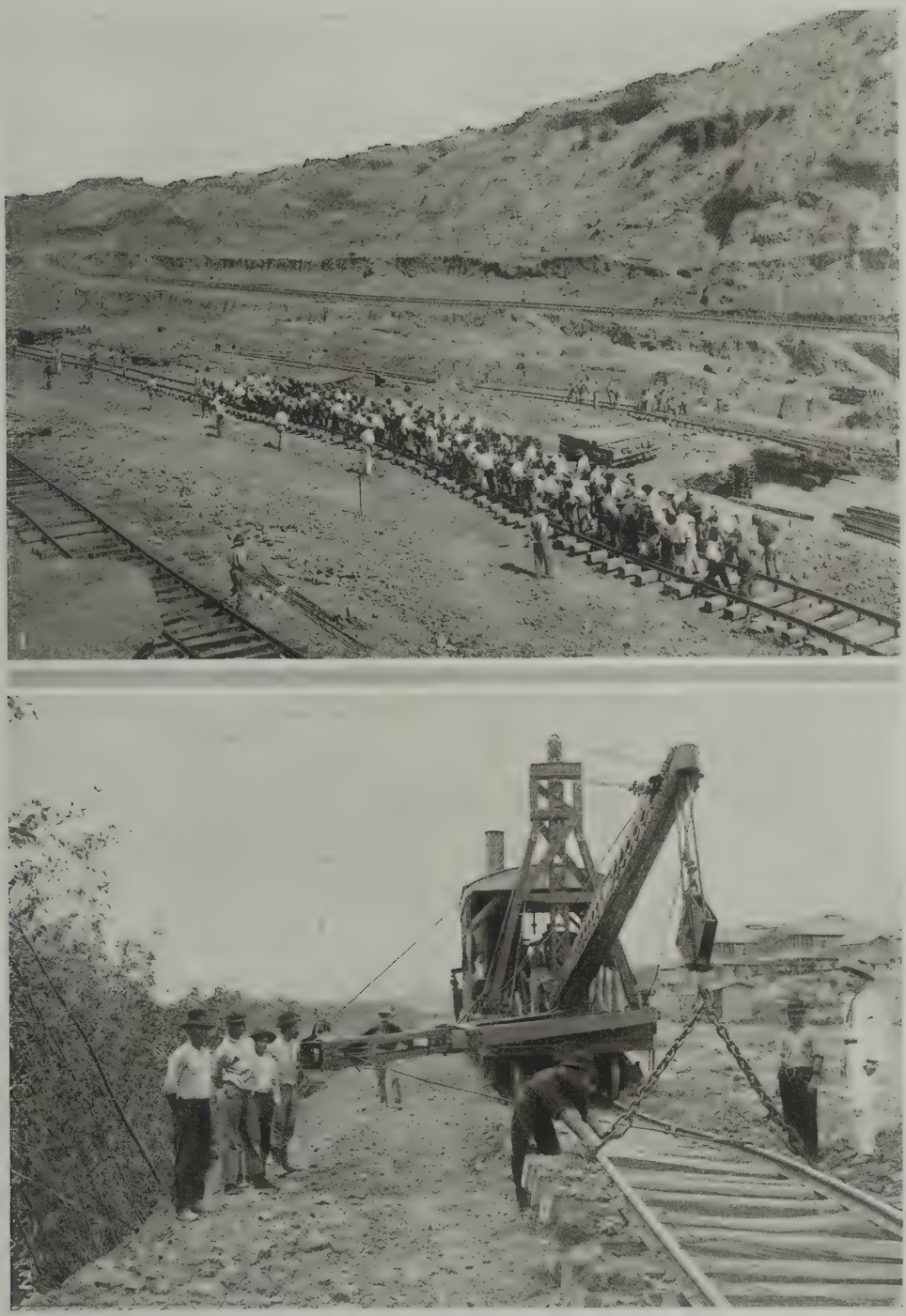


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4

1. Types of drill bits.
2. Vertical drill in operation.
3. and 4. Longitudinal section of Leyner-Ingersoll-Rand drills.
(Drilling equipment on the canal furnished by the Ingersoll-Rand Company of New York.)



Labor saving at Panama. The upper picture shows the old way of trackshifting; the lower one shows how many fewer men can do the same amount of work with a trackshifter, invented on the Isthmus. The ties being held by tie plates furnished by the Spencer-Otis Company of Chicago.

slip, under extreme torque, in the direction of the resistance of the pawl. This condition of torque may be brought about by jamming or binding of the bit in such a manner as to prevent rotation. Without this precautionary relief serious breakage and disablement of the drilling machine would ensue.

The percussion drill is most markedly different from other common forms of drilling machines by the great merit of being capable of drilling holes at an angle. This characteristic feature has been a factor leading to its present universal employment. Percussion drills are mounted on tripods, on frames supported by a carriage, or supported by hand, as in the use of the small hammer type.

The tripod type of mounting is most generally used. This form permits of holes being bored at any desired angle. Where holes are required of larger diameter and to greater depth, a vertical frame with guides the length of the drill feed, and carried on wheels, is used in land operations; in under-water rock work, drills of great power are mounted on vertical steel guides carried by a suitably designed vessel. For shallow holes of small diameter the lighter unmounted hammer drills are employed.

The small hammer drill, variously known as plug drill, buzzer, or Jack hammer in its different forms, is playing an important part in mining. The standard tripod-mounted piston drills have no equal in the class of work for which they are properly adapted, viz.: the drilling of comparatively large and deep holes at all angles; but as the diameter and depth of holes best suited to blast a given amount of material diminish, a point is reached where the use of the hammer drill is more economical. The drilling speed and consequent cost of compressed air and labor are proportionate to the area of the drilled hole. The hammer drill is of simple construction and has but one or two moving parts. Requiring but a moment to start new holes or change bits, the drill is actually "hitting the rock" probably 80 per cent. of the working time; for a standard heavy mounted drill, 50 per cent. is a good average. No special skill is required to operate the hammer drill, and one drill will perform the work of from ten to fifteen expert hand drillers. The hammer drill can be used in close quarters where a mounted piston drill could not be placed or hand hammers swung. The field of the hammer drill is in shaft sinking, stoping, ditching, replacing "mud capping," block holing, and any situation where holes of small diameter and no great depth are required.

The most common employment of rock drilling apparatus is in the drilling of blast holes, in mines, quarries, tunnels, shafts, open cuts, and rock excavation generally. To obtain the most efficacious results in the use of explosives in blasting, the explosive must be placed in the position indicated and governed by the nature and aspect of the variations of each formation and by the profile required in the finished excavation. To place the explosive in the position that may be indicated, the blast holes may require to be drilled at any angle from horizontal to the perpendicular. The power-actuated tripod and hammer drills are the only forms of drilling machines adaptable to the economical drilling of blast holes through this range of angularity.

On the land or dry work in connection with the canal, all of the drilling machines were actuated by compressed air. The economies of generating power in a central plant, the absence of exhaust steam and the smoke and heat from numerous portable boilers, which would augment the already high temperatures of a tropical climate, were some of the more evident benefits resulting from the use of compressed air instead of steam.

The vast extent of the mining and blasting operations entailed in the creation of the canal and the large connective and allied works included the situations and conditions to be met with in the operation of drills in tunneling, quarrying, shaft sinking, open cut work, and in sub-

marine rock removal. The rock drills employed were of the varied types and designs best adapted to work in the formations encountered and meet the special conditions of each class of work.

The geological formations in the prism of the canal, broadly stated, consist in the oldest rocks between Bas Obispo and Empire, of basic conglomerates, overlain by volcanic agglomerates, tuffs, lava flows, plugs, dikes and volcanic breccias, all much faulted and sheered. From Empire to Paraiso is a 500-foot sag or downwarp of dark, soft, friable, thinly bedded carbonaceous clays and shales, containing lenses of sand, gravel, marl, and basic tuff. The northern and southern rims of this sag are breccias with intrusions of basalt at Paraiso. This formation, which is estimated to be 250 feet thick, grades upward into sandy limestone and limy sandstone and limestone in beds three to thirty-six inches thick, separated from each other by thin beds of marly shale; these bedded rocks are weak and of low crushing strength. Shell and coral limestones are found at intervals across the isthmus, overlain with fine grained basic volcanic clay rock and containing locally lenses and beds of gravel, sandstone, carbonaceous and lignitic shale beds up to four feet thick, and lava flows twenty feet thick. This formation is weak, crumbly, and easily weathered.

The youngest rocks are intrusions, dikes, and local flows of basalt of a dark, fine hard texture, of high crushing and tensile strength, and of masses of volcanic breccia. The general formations of the under-water rock of the Atlantic and Pacific entrances of the canal are of coral or volcanic origin. The quarries at Porto Bello and at Ancon Hill are of basic andesite, basalt or trap.

This general statement of the nature of the geological formations encountered is given to illustrate their great structural variations and the range in texture, in composition, and in other qualities affecting the working conditions of the rock drills and governing the selection of the class of drilling machine most efficient in each situation. The primary object in blast hole drilling is to enable the blasting process to take place. The method that decreases the number of holes to be drilled over a given area by increasing the blasting effect at each hole will lessen the cost of drilling in proportion to the decrease in feet drilled per cubic yard of rock blasted.

The important factors, pertaining to the nature of the material being drilled, which govern the economical results, are the softness or hardness of the rock, cracks, seams, and the dip or angle of outcrop or strata, the homogeneity or irregularity in composition and formation, and the sludging or mudding tendency from the action of the drill bit.

The mechanical effect in cutting a hole in a homogeneous formation, where the number and force of the blows delivered by the rock drill is constant, as a general proposition, is, in cutting speed, in inverse proportion to the area of the hole. It follows therefore, other conditions remaining constant, that increase in the rapidity and force of the blows delivered in cutting holes of decreased area would produce a proportionate increase in depth of boring in a given time.

The intrinsic purpose of a blast hole is to provide access to that position in the mass where concentration of explosive will produce the most effective results in blasting. The economic rule as applied to the mechanical forces employed is therefore to drill holes of as small diameter as practicable when the holes are to be sprung, and large holes when springing or enlarging the bottom of the hole is not feasible.

The excavation of the Central division of the canal, extending 31.7 miles from the Gatun Dam to the lock site at Pedro Miguel, included the removal of between seventy-five and eighty million cubic yards of rock. In volume this approximates eighty per cent. of all the rock mined from the canal and quarries during construction.

All the variations in form, texture, or other qualities found in the rock excavated over the whole canal are found in the Cen-

tral division. The drilling operations of this division will be taken as representative of all the dry rock work. An approximation, based on over fifty million yards, would indicate that the rock from this division would classify by volume as consisting of eighty per cent. of soft rock and twenty per cent. of hard rock. Reference to the general geological formations already described will make clear the distinctions of hard and soft rock.

The average number of drills employed when the whole division was in active operating condition was, well or drop drills, 153; tripod percussion drills, 231.

Based on the drilling of 6,412,000 linear feet of blast holes bored for blasting 12,863,000 cubic yards of material, the performance of the well drill averaged six and one-quarter feet in depth of hole per hour, with an average labor operating cost of 6.68 cents per linear foot. The tripod drills averaged, including the drilling of toe holes and working in the hardest rock, five and one-eighth feet per drill hour, at an operating labor cost of 8.96 cents per linear foot. In drilling the hardest trap rock in Culebra Cut, based on cutting 6,297 linear feet, the average cutting speed of tripod drills was 2.47 linear feet per drill hour.

An average of 100 horizontal toe holes fifteen feet in depth were drilled each working day. Six hundred vertical holes nineteen feet deep were bored in the same time. These records of performance are of a period when the organization and working conditions had been developed to a condition productive of high economic and operative efficiency.

The variable nature of the materials drilled was particularly adapted, in a great portion of the excavation, to the use of well drills, owing to the mechanical design and operation of this type of machine being effective in boring holes through an overlay of earth, and through the seams containing loose materials, sand and gravel, so frequently encountered. These conditions and the proportionate depths of rock and earth are exemplified in the record of operation of twelve well drills on the Pacific division. During twelve months 86,827 linear feet were drilled; of this footage, 50,889 feet were through the overlay of earth, and 35,938 feet through a friable rock,—a relative proportion of about ten of earth to seven of rock. The average performance of each drill was about twenty-three linear feet of hole per day. A pipe casing was used in the drilled hole to prevent the overlay of earth from caving into the hole.

From the inception of the canal work in 1904, until the end of 1912, 725 rock drills of the different types had been purchased for use on the canal work at a cost of $288,376. This number of drills approximately served to complete the canal, as operations were at the height of activity and the maximum quantity of plant in use in 1912. From this period the quarrying and other rock sections were ceasing operations owing to completion of work; this led to the reduction and retirement of drilling plant.

The crushed stone used in the concrete construction of the locks and other structures at Gatun was produced at the Porto Bello quarries on the Atlantic side of the isthmus. The crushed stone used in similar structures in the Pacific division, as the locks at Pedro Miguel and Miraflores, was produced from the quarry at Ancon Hill.

The cost of quarrying, covering the production of over 1,300,000 cubic yards, averaged 95.57 cents per cubic yard at the Porto Bello quarries, and the unit-cost of drilling was 4.4 cents.

In the production of about 1,700,000 cubic yards from the Ancon quarry, the average cost of quarrying was 53.85 cents per cubic yard, of which five cents was the unit-cost of drilling. Both quarries were of igneous formation of basalt or trap. Percussion tripod drills of three and five-eighth-inch piston diameter were in quite general use at Porto Bello; at Ancon, in addition to the tripod drills, a number of well drills were in use. The well drill,

because of its slower and less powerful blow and the larger area of holes drilled, penetrates these verv close and hard rocks but slowly.

Subaqueous rock drilling was performed in the Atlantic entrance of the canal and in the Pacific entrance. The tidal conditions of the Atlantic give a range between rise and fall of about fourteen inches; on the Pacific side the extreme range is about twenty-four feet.

The rock formation on the Atlantic side is of soft, easily worked coral formation. On the Pacific side the rock is of volcanic origin, of fine texture and of medium hardness.

The nature of the coral deposits to be drilled and the most favorable tidal conditions permitted of very economical results being obtained, on the Atlantic side, with an improvised drilling plant.

An old hull, used on the French works, was fitted with eight old well drills and used as a drill barge. The individual boiler was removed and steam for actuating the drills was supplied from a central boiler. These drills were placed four on each side of the barge. The two lines of drills were twenty-two feet apart, and the drills in each line fifteen feet apart. The total cost of this improvised installation was $4,000. An average of eight holes was drilled, loaded and fired each day.

In mining 174,580 cubic yards, of which 83,800 cubic yards was an overlay of earth, the cost was 4.5 cents per cubic yard, or if all expense is charged to the rock, the cost would be 8.7 cents per cubic yard. The cost per cubic yard of 191,872 yards of subaqueous rock without an overlay of earth was 7.9 cents.

The subaqueous drilling plant in the Pacific entrance of the canal followed in general design and process the standard American system as carried out on the Great Lakes and the St. Lawrence River. There were minor modifications in the spud mechanism to meet the tidal variation in level.

The greater physical difficulties to be met with in the removal of the under-water rock on the Pacific side required a more elaborate and substantial plant than was needed on the Atlantic side. These physical features were the great range in tidal levels, the harder rock formations, and the larger volume to be removed.

The hull of the drill barge was of steel, 112 feet long and 36 feet 8-inch beam. Two longitudinal and six transverse bulkheads divided the hull into twenty-one watertight compartments. Two of these compartments amidships were utilized for water storage and other of the compartments contained six fuel oil tanks, each of forty-barrel capacity. Four timber spuds, twenty-four inches square, were located towards the corners of the hull. These spuds were each controlled and lifted by an independent pair of engines connected by gears with steel racking on the spuds. The function of these engines had a controlling influence on the performance of the plant. The engines were under steam pressure which exerted a downward thrust on the spuds or lifting effect on the hull while the drills were working. This thrust was of a force sufficient to keep the vessel above her line of normal flotation.

The proportion of the weight of the vessel on the spuds served to keep the vessel anchored or fixed in position over the holes being drilled as the water level changed with the stage of the tide. The mechanical principle involved is the condition of equilibrium established when the weight or downward pressure on the spuds equals the resistance of the steam pressure. The rise or fall of the water in which the vessel floats disturbs this equilibrium, with the resultant effect that the engines automatically reëstablish this equilibrium concurrently with the increase or decrease of load on the engines,—the engines are overhauled against the steam pressure, or because of the steam pressure force the spuds downward.

Three drill frames or towers carrying percussion drills were in line over the gunwale on one side of the vessel. The frames were supported on tracks and were movable in the direction of the length of the vessel by

connection with an endless chain operated by hydraulic power. The frames had a travel of eighty-five feet. The drill frames or towers, about forty feet in height, were provided with guides, on the outboard side, in which were operated sliding saddles or crossheads to which the percussion drills were bolted. The length of these slides, which approximated the height of the towers, was the length or range (less the length of the crosshead) of the feed or travel of the rock drill. This long range was of advantage, in this design, in providing for feeding the drill according to the depth of the rock cutting, and the changing positions of the drill as affected by the stage or level of the tide. The crosshead to which the drills were bolted was of sufficient weight to resist the lifting force exerted by the drill when striking. The up and down movement or feed of this crosshead was controlled by a steam-operated hoisting winch located on the base of each tower and connected by a steel hoisting cable running up over the tower and down to the crosshead.

The drills, three in number, were of five and one-half-inch piston diameter, steam actuated, and of the Ingersoll-Rand type of submarine drill. The drills in their action and design were similar to the familiar form of percussion rock drill as mounted on tripods, the main differences being in greater power, weight, and corresponding structural increase in dimensions and strength. Drill steels or bars to sixty-five feet in length were used. Steam was supplied to the drills and hoists from a central boiler through swivel and slip pointed pipes. The vessel was manœuvered on four Manila cables attached to kedges.

The average performance of the plant, taken from 24 months of continuous operation, was as follows:

During this time the drills worked 22,854 hours (i.e., the total of hours in work on the separate drills—drill hours) and drilled 286,005 feet of hole of an average depth of 16.5 feet each. The drills averaged thirteen feet of hole per drill per hour. The maximum over a period of one month was 21.64 feet per drill hour, and the minimum over a like period 5.9 feet per drill hour. The unit average cost, over a period of twenty-four months of operating, drilling and blasting, was 39.62 cents per cubic yard.

In forming the Pacific entrance two methods of drilling the under-water rock were employed,—by the drill barge as described and by the well drill. At places where rock below the surface required to be drilled, there was an overlay of earth that came above the water level. Well drills were used in these situations. The rock was the same as that drilled by the submarine drills on the drill barge. The operations of the well drills and of the submarine drills in the same formation demonstrated the relative speed of boring of both types of machines.

During nine months of operations with an average number of 11.2 drills working, the total linear feet drilled was 52,777; of this footage, 19,756 feet, or about thirty-seven and one-half per cent., were through the overlay of earth.

Assuming twenty-six eight-hour days to the month, the performance of each drill averaged 4712.2 feet in nine months, which would equal 523.5 feet per month and 2.52 feet per drill per hour as the average work through earth and rock. The submarine percussion drills averaged in two years' work thirteen feet per drill per hour.

This speed of penetration of the submarine drill is far in excess of the performance of any other type employed on the canal.

The Ingersoll-Rand Company supplied the majority of the drills used on the canal works. This same firm supplied 300 tripod drills of three and one-quarter-inch piston diameter to the French Company. For the commission the firm supplied 184 drills of three and five-eighth-inch piston diameter. Of this number twenty-five were of the tappet valve type, the remainder of the air thrown valve type, or the auxiliary valve form. Fifty drills, tripod mounted, of four and one-half-inch piston diameter, twenty-five of each being

of the air thrown and tappet valve form, were also furnished. These drills, because of their weight, were not as handy as the three and five-eighth-inch size, any gain due to their greater striking force being somewhat offset by the inconvenience in shifting position in starting new holes. Of the smaller tripod machines there were fourteen of two and one-half-inch piston diameter and fifty-eight of the two and one-quarter-inch piston diameter. In addition there were two very heavy tripod drills of five-inch piston diameter, and six unmounted submarine drills of five and one-half-inch piston diameter used on the drill barge in the Pacific entrance of the canal.

A rock drill, in common with all other mechanical means of converting energy into useful work, will perform an amount of work that is constant where the factors of force, time, speed, resistance and other influencing causes remain constant. In the actual cutting of a drill hole the force expended is in direct proportion to the area of the hole, and the time of cutting in inverse proportion. An increase in the number of blows in a given time affects a corresponding increase in penetration. A decrease in the area of the hole augments this in proportion to the lessened area. Increase of force to the blows will proportionately further increase the cutting speed. These are the fundamental theoretical conditions governing the performance of a percussion rock drill.

Drill holes range from less than one-half inch in diameter to eight inches or more, as in well drilling. The highest speed of striking is in the small hammer drills, which strike upward of 2,000 blows per minute. The striking speed successively diminishes from the tripod mounted hammer drill, the smaller to larger sizes of direct steam or air-actuated drills, to the largest size of submarine drills striking about 250 blows a minute, and culminating in the slow acting well drill striking less than sixty blows a minute.

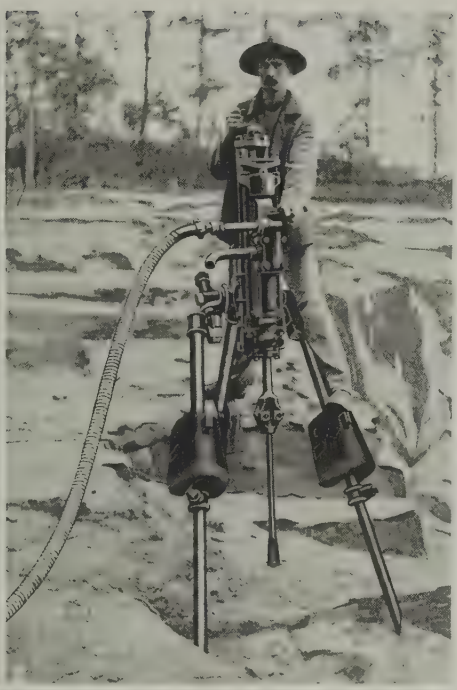
The striking force of the different types runs from the light rapid blows of the small hammer drills to the powerful steam-hammer-like blows of the largest subaqueous drilling machines.

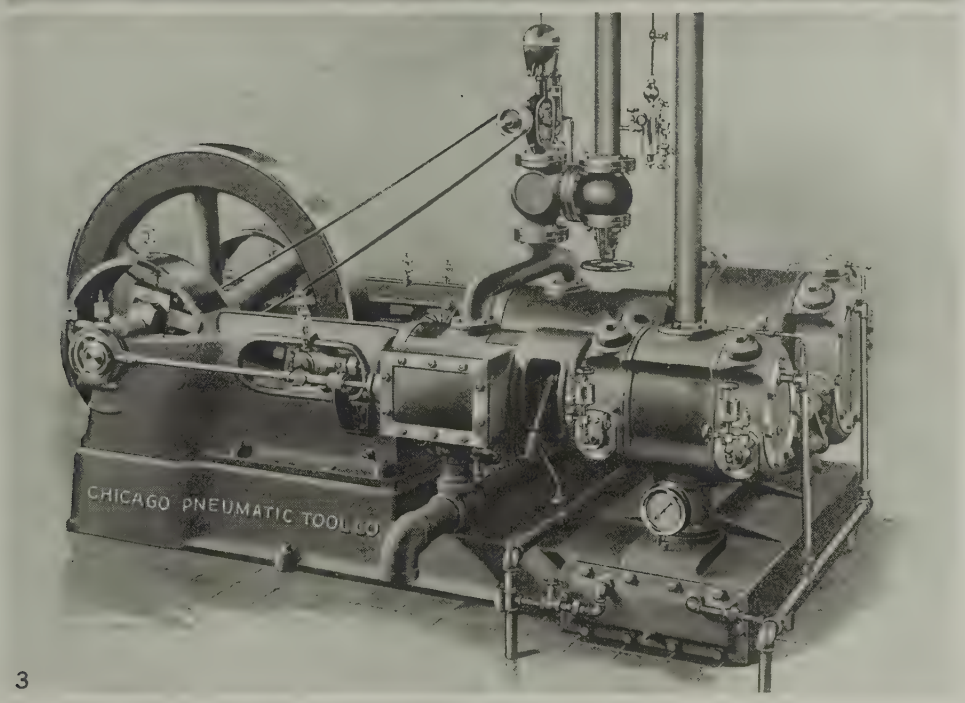
To obtain reliable records of the performance of any type or class of drilling machine it is essential that more or less stable conditions obtain in the formations drilled. The extreme variations in formation and the heterogeneous composition of the rock masses, on the isthmus, brought about by the effects of volcanoes and earthquakes, heat and cold, coral formations, water and other agents of denudation and transport and the sequence of natural phenomena, permit only of most general deductions based on the average collective performance of numbers of drills working in constantly changing and differing conditions. These general conclusions are evident from what has already been stated and require no elucidation for their apprehension.

It may be affirmed that as an economic factor the rock drill was indispensable to the creation of the canal, and its work the physical requisite preliminary to the disruption and displacement of the vast masses upheaved by the great natural convulsion of the surface of the earth which formed the barrier to the reëstablishment of an interoceanic passageway connecting the Atlantic and Pacific as existent in geologic time.

The first use of compressed air to any extent as a means of power transmission was for the operation of drills in mines and tunnels. This followed the development of the steam drill. The superior efficiency of the steam drill as compared to hand drilling having been demonstrated, its use in mining work was advocated, and the use of steam being obviously objectionable, some other elastic fluid had to be utilized, with the natural result that the air compressor was developed to meet the demand for a supply of this fluid in the form of compressed air, which not only has none of the disadvantages of steam, but instead, positive advantages by way of added ventilating effect, allowing the machines to re-







3

1. Underground compressor drilling.
2. Surface drilling.
3. Air compressor for drills.
(Supplied the canal by the Chicago Pneumatic Tool Company, Chicago, Ill.)

main cool, and increasing the durability of packings and wearing parts on account of more perfect lubrication.

The success of this system of power transmission as applied to rock drills suggested its application in other fields, and inventions multiplied.

At first its use was confined to larger operations, and in addition to rock drills we had such large and unwieldy tools as channelers, gadders, etc. Later these tools were made in smaller sizes adapted to the use of one man for coal mines and the mining of mineral ores, and these tools have continually decreased in size until now they are made almost as diminutive as a watchmaker's hammer. Steam engines of most approved types, electric motors direct connected, common water wheels, Pelton wheels or the more modern turbines furnish the power for compressing the air. Air compressors or pumps are constructed to be driven from belting, with gears or combined direct with a reciprocating steam engine. The initial power being settled upon, it only remains to lay the mains about the plant, provided at convenient distances with valves, to which, by means of rubber hose, the individual tools may be connected.

This gives a flexibility to the plant, hitherto unknown, for the mains once laid and convenient openings provided, any desired tool may be brought to bear at any part of the shop, yard, building, bridge or roadbed. The importance of the drilling operations at the Panama Canal is shown by the fact that at least five great firms in the United States furnished the various forms of drilling equipment.

The pneumatic equipment furnished the Isthmian Canal Commission by the Chicago Pneumatic Tool Company, consisted of air compressors, rock drills, air drills for drilling, reaming and wood boring, pneumatic hammers for riveting, chipping, calking, shell riveters, rivet busters, compression riveters and hoists.

The features of Chicago Pneumatic Air Compressors are simplicity of design and construction, great structural strength, liberal bearing surfaces, adequate valve and port areas, and effective automatic regulation. Their speed ratings are moderate, avoiding the present-day tendency to overrate capacity. The steam cylinders are duplex and the air cylinders two-stage or compounded, and at 150 revolutions a piston displacement of 1,055 cubic feet of free air per minute is obtained. Chicago Giant Rock Drills and Plug Drills were used in great numbers in the drilling of blast holes. These drills are built to stand the roughest usage and while making records for economical upkeep, do their work with great speed. Hundreds of Little Giant Air Drills were furnished the commission by this company for use in the machine and repair shops to assist in the work of maintaining the machinery of various kinds installed along the route of the canal. The Little Giant Air Drill is a portable engine using compressed air as operating fluid. Four single acting cylinders arranged in pairs accommodate the four pistons which are connected in pairs to the opposite wrists of a double crank. A pinion on the crank engages with a large gear wheel to which the drill spindle is directly connected. Little Giant Air Drills have ball bearings on the crank which eliminate much of the friction and thereby increase their power to a marked degree.

There is little work in the way of drilling in metal, reaming, tapping, wood boring or flue rolling that cannot be done advantageously with an air drill.

Hundreds of pneumatic hammers for riveting, chipping and calking were used on the work. All the pneumatic tools supplied by the Chicago Pneumatic Tool Co. were of the highest efficiency and gave uniform satisfaction wherever used in the canal construction.

The largest bulk of rock excavation was naturally in the Culebra division, nine and one-half miles long. The character of rock ranged from shale so soft that it was excavated as it stood by the steam shovel, up to hard, blocky trap rock.

While well drills or churn drills were much used in Culebra Cut for the vertical blast holes, all of the flat or horizontal holes at the bottom of the benches, and a good share of the vertical holes in hard rock, or where twenty-foot benches were employed, were drilled with ordinary air rock drills, mounted on tripods. In this character of work, the Sullivan rock drills and hammer drills of the Sullivan Machinery Company of Chicago played an important part.

About one hundred and twenty-five of the rock drills and thirty-five or forty of the hammer drills were employed. In connection with the excavation of the lock pits, it became necessary to cut smooth rock trench walls, unshaken by the jar of blasting. To accomplish this work, 24 Sullivan channeling machines of the largest size were used.

Much of the heaviest and hardest of the drilling work was at Bas Obispo, where the cut was about one and one-half miles long. The formation here was solid, consisting of a tough, close-grained trap-like rock, requiring very thorough drilling and blasting in order to prepare it for the steam shovel. A ballast quarry was also located here.

In the fall of 1905, twenty-five Sullivan rock drills and a number of churn drills were assigned to this cut, and the Sullivan machines were kept steadily at work here until the excavation was completed. Two holes, twenty to twenty-seven feet deep, were considered a day's work for one drill. The machines were at first operated by steam, but after about a year, the permanent air lines were installed, and for the last six years of work, compressed air was supplied for all drilling operations. Similar drilling methods were employed in the lock excavation, in the terminal work, and in the two rock quarries.

In this work the tappet valve type was selected, on account of the varying hardness of the rock, the presence of mud seams, and the low steam and air pressure which were encountered on account of the distance from the central power plants. The ends of a rocker project into the piston chamber and are shaped so as to afford an ample bearing on the inclined surfaces of the piston, reducing wear and shock to a minimum. The action of the rocker pushes the flat valve back and forth, in a direction parallel to that in which the piston is moving, so that wear is distributed evenly over the whole surface of both valve and its seat. The rocker is of tool steel accurately formed and tempered to proper hardness. The cylinder and valve seat form a housing allowing the rocker free motion, without side or vertical play. The sloping surfaces of the piston are also hardened by special heat treatment, to reduce wear. This valve motion is very economical of air or steam, and secures a rapid blow and powerful recovery, which are well adapted to conditions found on the canal.

In addition to the drills above mentioned, the Sullivan Machinery Company furnished large quantities of drill steel for use on the canal. One order of drill still was shipped from the Chicago works of the company, comprising seven freight car loads in bulk.

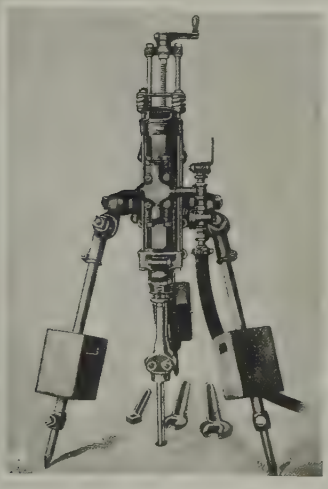
From thirty-five to forty Sullivan hand feed hammer drills, employing hollow steel, were used in the Ancon and Porto Bello quarries for breaking up fragments of rock too large to be handled by the shovels, and for other light excavation. These machines weigh twenty-five and forty pounds respectively, and are operated by a single man. They proved of great value in this block hole work, being much more economical than the mud capping method previously employed. An important feature of their design consists in the interior connection of the exhaust ports under the control of an outside valve, so that varying amounts of the exhaust air from the cylinder can be led into the top of the hollow drill steel for cleaning the hole.

Another interesting feature is the cushion valve, which is arranged to entrap a small quantity of air in the rear end of the cylinder, providing a cushion for the piston on its backward stroke, thus greatly









1 and 3. Sullivan drills at work on the canal.
2. Trench cut by a Sullivan channeler.
(Drills and channelers supplied by the Sullivan Machinery Company, Chicago, Ill.)
4. Type of drill used on the canal furnished by the Wood Drill Works, Paterson, New Jersey.

reducing the vibration of the tool and the fatigue of the operator.

Channeling the Lock Floors

In 1907 the Isthmian Canal Commission purchased twenty-four Sullivan channeling machines, some furnished with boilers for operation by steam, but the majority supplied with air reheaters to render their operation by compressed air as economical as possible. The use of stone channeling machines in engineering work dates from 1892, in the construction of the Chicago main drainage canal. In this enterprise, fifteen miles of canal had to be cut through solid rock. The advantages of a channeled wall over a blasted wall are numerous; the straight, smooth, solid cut made by the channeler, avoids any necessity of either trimming or filling to the engineer's line, the walls left by the channeler remain as solid as the rock itself, not weakened or shattered by explosives, and retaining walls to prevent rock falls or slips are obviated.

Another important advantage secured by channeling consists in the fact that the rock ground or structures adjoining the channeled walls are not disturbed or shattered, and it was in this connection that the channelers found their principal use on the Panama Canal. It had been planned at first to channel the Culebra division from end to end. This idea was abandoned, however, and the use of the machines was restricted to the sites for the locks.

The total amount of channeling performed in the locks was about three-quarters of a million feet, and included, in addition to the lock floor work, the cutting of trenches beneath the curtain walls and across the site of the dam at Gatun. In these trenches, cut-off walls were built to divert the underground water, the presence of which was endangering the foundations of the locks and dam. In this case, also, it was of importance that adjoining ground should not be disturbed by blasting that might affect the stability of the foundations for the great concrete walls.

The design of the Sullivan channelers is exceedingly simple. There are only two engines, the chopping engine and the feed engine, which drives the machine back and forward along the track through worm shafts and gearing. The feed engine also controls the power feed and hoist of the chopping engine. The valve motion is such that the operation of the machine, as to kind of blow and speed, may be modified to secure the best results for any stone and any operating conditions. Special valves in the exhaust ports permit cushioning of the blow, thus preventing damage to the front head, in case a mud seam or other irregularity in the rock is encountered. This was particularly valuable in the broken formation at Panama.

The twenty-four Sullivan channelers were the only channeling machines used on the canal.

The company also supplied much of the equipment for the diamond drilling in testing the location of the canal and the locks and dams.

The record for the number of a particular make of drill on the Panama Canal work belongs to the Star Drilling Machine Company of Akron, Ohio, which maintains branch plants at Portland, Oregon, and Chanute, Kansas.

This company furnished 214 drilling machines for blast hole and other work on the canal, and these figured importantly in the rapid and economical removal of the vast tonnages of rock and earth with which the canal engineers were confronted.

The Star Company makes a specialty of portable drills, and these in various forms were so widely used in the canal's construction that the company made the poetical boast that "Of a truth have the Stars lit the way 'cross Panama."

This form of drill is variously used for blast holes, well drilling, copper mine prospecting and many other forms of drilling. Gasoline, steam or electric power is used in their operation, the steam operated machines being generally used where coal or wood is easily accessible, and gasoline where the ordinary forms of fuel is scanty.

Where electric power is available, the machines are equipped for either direct or alternating current.

One of the advantages which led to the great number of these drills at the canal was the ease with which they could be set up or moved. The entire machine, including the engine and boiler, is compactly mounted on wheels, the traction style machines propelling themselves from place to place with their own power, while the others are easily hauled. The traction machines are powerfully back-geared for hill climbing and with high speed for fast traveling on free roads.

Other types of rock drills used on the canal in large numbers were the improved drills both of steam and air power, manufactured by the Wood Drill Works of Paterson, N. J. This company also furnished its heavy type bronze hose couplings in great numbers.

The Wood drills were used in the construction of the Miraflores lock chamber, in the Culebra Cut, and in getting out trap rock at Porto Bello for the Gatun locks. For these operations, this type of drill was selected after six months of competitive tests, the selection being based on quantity of work performed, long life of the machines, and ease of operation.

The manufacturers of these drills were the first to use vanadium tungsten iron in the construction of their drills, and their plant is devoted exclusively to the manufacture of drills.

The climatic conditions at the Canal Zone had no effect on these drills, it being claimed for them that they work equally well in either tropical or frigid climates. Simplicity and solidity of construction was one of their features, the motto of their manufacturers being that in the canal work they could be "cleaned up with a sledge hammer," "wiped off with a scoop shovel" and be ready to continue operations.

The drills, great and small, used to such large extent on the canal, and which were so large a factor in the rapid excavation, demonstrate that the United States leads the world in this class of machinery. These busy machines, which paved the way not only for the water channel, but for the lock emplacements and other great features of the canal's construction, will remain among the first of the industrial implements and products which aided the directing minds of the work to bring it to rapid and successful completion.

Explosives on The Panama Canal

The casual visitor to the canal during its construction had a good opportunity to see in operation the powerful allies which man now has at his command, which make possible the accomplishment of such magnificent engineering projects. He saw the mighty steam shovels eating into the cut like so many living giants, the myriads of locomotives hauling away to the dumps what was once a part of the backbone of two continents, and the great cranes so gently and so easily lifting into place the massive sections of locks.

And then he met the blaster out on other parts of the work handling the mightiest of them all, the insignificant looking little rolls of yellow paper about one and one-quarter inches in diameter and eight inches long, that made possible the work of all the other giants. For the most powerful steam shovel cannot dig, nor the greatest locomotive haul, solid rock.

The thoughtful person is therefore led to wonder what were the successive steps which have placed at man's command this greatest of all forces, lying so docile in the hand of the powderman; now held together by a couple of turns of waxed paper, yet which upon his demand exerts force of more than 500,000 pounds per square inch, resistless in its force, supreme in its conquering power.

The history of the successive steps which have given us this potent agent, dynamite, without which so many of the greatest engineering projects of to-day would be impossible, is however, unnecessary here. It will be sufficient to sketch briefly what dynamite really is, and to give a short







1. Raising cases of Du Pont explosives from a deep lighter at the canal.
2. Du Pont dynamite in action on the Isthmus.
3. Loading a cargo of dynamite for the canal.
(Du Pont Powder Company, Wilmington, Del.)

account of how that which was used in digging the Panama Canal was supplied.

The explosive basis of all dynamite is nitroglycerin. Everybody is familiar with ordinary glycerin as obtained from the drug store. If glycerin is treated under proper conditions with strong nitric acid, assisted by the presence of sulphuric acid, it is converted into nitroglycerin. The latter differs from glycerin not only in having explosive properties, but unlike glycerin it is almost insoluble in water, so that all traces of acid can readily be washed out, leaving the pure nitroglycerin. The chemical action which occurs is similar to that when nitric acid acts upon potash, converting it into potassium nitrate or saltpetre. The explosive properties result because the glycerin, a combustible, has had introduced into its chemical structure groups of atoms containing sufficient available oxygen to support the combustion, independent of air. The same group is introduced into potash when we convert it into saltpetre with nitric acid, and the only reason why saltpetre is not an explosive is because, while the oxygen is there, the combustion is not. By mixing a combustible with it—sulphur and charcoal, for instance—we obtain an explosive, blasting powder.

Nitroglycerin itself is not very well adapted to blasting, for several reasons. Being a liquid, there are many situations constantly arising in blasting operations where it would be difficult or impossible to load it. Then again, it is very sensitive to concussion or friction, which makes it unsafe to handle or transport. These and other conditions finally led to its general applications in the form of dynamite, which in spite of the terror which the name inspires in the mind of the uninitiated, is by all odds, one of the safest of explosives. For, in an explosive, great strength is a measure of efficiency and not of danger; while on the other hand a comparatively weak explosive may be over-sensitive, unstable, and erratic in its behavior, and therefore dangerous.

The first dynamite consisted merely of a very porous variety of earth (Kieselguhr) saturated with nitroglycerin, and its explosive qualities were due entirely to the latter. While this immediately produced a practical blasting explosive of about the consistency of and closely resembling brown sugar, which could be packed into cartridges and safely transported and handled, it is a kind of dynamite that is very little used in this country to-day. Here we prefer to use, instead of inert earth, an absorbent which is of itself an explosive, so that when fired we obtain the effects of two explosives working together. So we use for our absorbent a mixture of woodpulp and saltpetre or its equivalent, which forms a very good absorbent, and a mixture which also explodes with about the force of blasting powder under the influence of the heat from nitroglycerin.

A sixty per cent. strength dynamite made in this way is more than equal in strength to a seventy-five per cent. dynamite made with the inert earthy base. The gain in strength is not the only advantage, however, as the explosive base and the many modifications of it which are possible enable the chemist to control the quickness of the explosion as well as its strength, thus adapting different kinds of dynamite to practically every kind of work for which a blasting explosive is required.

Dynamite has many characteristics which give it an immense advantage over black powder, especially in a piece of work like the Panama Canal. Among the first of these is its resistance to water. While the Panama rock was soft enough to admit of using black powder—and some was used very successfully in the early part of the work, in holes that were chambered or enlarged at the bottom with dynamite so that they would hold enough of the black powder—the fact that black powder softens when wet into a black mud that will not explode forbids its use in a good deal of work where it would otherwise be effective. On the other hand, varieties of dynamite are sold by the du Pont Company which

can be immersed in water for a long time without material impairment of their explosive force. That supplied for the Panama work was not as waterproof as this, as the saltpetre would be acted upon by the water in time. But practically, the particles of saltpetre are protected so well by their coating of nitroglycerin that they easily withstood immersion for any length of time required in the work. Indeed, it is safe to estimate that three-fourths of all the dynamite used on the canal was fired after it had been submerged under water in the bore holes for periods of from several hours to several days.

Between January, 1905, and June, 1912, the E. I. du Pont de Nemours Powder Company, Wilmington, Delaware, supplied the following enormous quantities of material for use in constructing the Isthmian Canal: 33,000,000 pounds dynamite, 3,570,000 electric fuses (electric blasting caps) 2,800,000 blasting caps, 4,200,000 feet fuse, 20,000 pounds leading and connecting wire, and 230 blasting machines.

The entire quantity of dynamite was manufactured at the du Pont Repauno plant, which is located near Gibbstown, New Jersey, on about two thousand acres of land bordering on the Delaware River over which are spread the four or five hundred buildings of the works.

Tons of material required treatment before reaching the form of finished dynamite ready for use in blasting operations on the canal work. Each principal raw material was put through special processes in various departments of the du Pont Company's Repauno plant under the supervision of trained experts.

The sulphuric acid used in the preparation of the powder was all manufactured at the Repauno plant of the du Pont Company by the contact process. Nitric acid, the most important acid used in the manufacture of the nitroglycerin, as well as numerous other explosives, is made on a very large scale at the Repauno plant. The two prime materials used in its manufacture are Chile saltpetre (sodium nitrate) and sulphuric acid. The sodium nitrate, first dried in mechanical dryers, is transferred to large cast iron retorts, sulphuric acid added and a sufficient amount of external heat applied to start the chemical reaction which results in the formation of nitric acid. The nitric acid so formed is distilled, condensed and mixed with sulphuric acid and stored in tanks until ready to be used. The nitric acid works at the Repauno plant of the du Pont Company are to-day the largest in the world, the output running into millions of pounds per annum.

To produce the nitroglycerin, the most powerful of modern explosives and the base of the dynamite used on the Isthmian Canal, still a third important material is treated at the Repauno plant in a separate department, *i.e.,* crude glycerin, a by-product of refinement known as "dynamite glycerin."

The sulphuric and nitric acids are combined into "mixed acid" and stored in huge tanks, from which point the latter is transported to the nitrating houses, where it is introduced into nitrators (large iron bowls equipped with appliances for cooling and continually agitating the contents), after which the glycerin is slowly added, great care being exercised during this operation to insure against sudden rise of temperature. A thermometer is located at a convenient point in the nitrator to enable the operator to determine changes of temperature during the process of nitration. When the nitration of the glycerin is complete the contents of the nitrator, which now consist of a mixture of nitroglycerin, water and the excess acid, are conveyed by means of a gutter or trough to the separating house. Here the nitroglycerin, which is lighter than the acids, rises to the top of the mixture, thus facilitating the separation of the liquid explosive from the "waste acids."

After separation is completed, the nitroglycerin is delivered to one or more wash tanks and subjected to the purification treatment. The finished nitroglycerin is





1. Keystone Explosives in action at the canal.
2. Solid train of dynamite ready for shipment to the Isthmus.
(Keystone Powder Manufacturing Company, Emporium, Pa.)

tested for purity or neutrality with an extremely sensitive litmus paper made expressly for the purpose in the laboratories of the du Pont Company, and then sent to storage tanks until required for use in manufacturing the various grades of dynamite and gelatin produced by the Repauno plant.

The waste acid is transported to the acid recovery department of the plant, where it is separated into its component parts (nitric and sulphuric) and again used in the manufacture of nitroglycerin or for other purposes.

The next step in the manufacture of the dynamite is the mixing of the nitroglycerin with dry ingredients by which it is absorbed. This operation is carried on in a special mixing machine.

From the mixing houses the loose dynamite is sent to the cartridge packing houses and packed in suitable printed parafined paper shells.

In a separate building, the box packing house, the dynamite for the isthmian canal was put up in fifty-pound wooden cases containing five ten-pound moisture-proof cartons, each, and in this condition finally reached the storage magazines of the plant to await date of shipment. The dynamite was transported over tramways from the magazines to the wharves of the Repauno plant on the Delaware River and loaded on ships bound direct to Colon.

The workmen in the explosive buildings are an intelligent, sober lot of men, carefully instructed as to their duties in connection with the various processes carried on. They wear pocketless uniforms and special rubber-soled shoes, and have separate buildings from those in which they work for changing their clothes.

For the proper use of dynamite, certain accessories are required which can be grouped under the general term "Blasting Supplies."

Of these the first and most important is the detonator. The detonator is required because dynamite, if ignited, cannot be depended upon to explode like blasting powder. Indeed, if unconfined it will generally burn away with a bright hissing flame without exploding at all. When confined it will explode oftener, but even then it does not develop its full force. To bring about uniformity in its action, therefore, a detonator is used. This consists of a copper capsule containing a small charge of fulminate of mercury, which always explodes at once upon ignition, and in contact with dynamite brings about the most effective type of explosion of the latter.

The detonators used for blasting are of two kinds. One kind consists merely of an open copper capsule containing its charge of fulminate in the bottom, and of a suitable size to be crimped upon the end of a piece of fuse. Thus a piece of fuse, which ordinarily would only set fire to a stick of dynamite, when equipped with one of these blasting caps and the cap inserted into the dynamite is capable of bringing about the most effective explosion (detonation) of any quantity of the latter.

The other kind of detonator consists of the same kind of copper capsule, a little larger in diameter, with the usual charge of fulminate at the bottom. But in place of the open end to receive the fuse, it is equipped with two insulated wires which extend into the cap through a composition plug. The ends of these wires within the cap are connected by a very fine piece of platinum wire, which is surrounded by some of the fulminate so that when an electric current passes the platinum wire becomes red hot and fires the detonator. The complete device is known to the trade as an "electric fuse."

The rest of the blasting supplies comprise the fuse, blasting machines used to supply the electric current, the wire required for making the connections and the testing instruments like the du Pont galvanometer and rheostat.

The major part of the blasting supplies, *i.e.*, electric fuses, blasting caps, etc., were manufactured at the Pompton Lakes, New Jersey, plant of the du Pont Company, and were, with the exception of the elec-

tric fuses, ordinary commercial products. When first called upon to supply electric fuses, the ordinary goods, such as were in common use in this country, were furnished, but it soon became apparent that the severe and unusual conditions under which they were to be used at Panama were such that something special would have to be developed. An expert was sent to the canal to study conditions under which the blasting was done and he reported, among other things, that the holes in which the dynamite was loaded were generally partly filled with a saline solution of an unusual nature owing to the volcanic origin of the rock. This solution was a fairly good conductor of electricity, and had surprisingly great powers of penetrating the insulation of the fuse wires as well, resulting in a considerable leakage of current under such abnormal conditions. After solving the difficulty concerning the kind of wire to use, a still further difficulty was encountered as the excavating progressed, deepening the cut below ground level. This necessitated a second trip by an expert of the du Pont Company to the isthmus to further study conditions. As a result it was found necessary to make the electric fuses more waterproof than had been the practice in the past without resorting to the expensive method of covering the detonator with gutta percha, since the situation was, to all practical purposes, similar to submarine blasting. The development of the present waterproof electric fuses resulted, which from the point of quality are superior to anything of the kind previously manufactured in this country, and which met the severe test of the work on the canal with practically perfect success.

Supplying explosives and blasting supplies for Panama, therefore, resulted in a lasting benefit to all users of explosives by imposing abnormally severe conditions. In order to meet these conditions the du Pont de Nemours Powder Company improved its regular product instead of producing a special grade for the isthmian canal trade. With this improved product it seems reasonable to suppose that conditions in the United States will not be so unusual as to cause the du Pont Company trouble from poor execution.

Prominent among the companies furnishing explosives for the excavating and quarrying work on the canal was the Keystone National Powder Company, with factories at Emporium and Sinnamahoming, Pa. In fulfilment of successive contracts, begun in 1908, this company made dynamite shipments aggregating nearly 30,000,000 pounds in the course of the five years following. The largest single shipment reached 1,225,000 pounds, or far more than was required in the removal of the once famous Hell Gate as an obstruction to the water traffic of New York City.

Each shipment went forward under the supervision of an expert crew, by rail to Baltimore and thence by steamer to Colon. Special arrangements for safe transportation were made throughout the entire journey. The dynamite was specially prepared to withstand climatic influences, the absorbing material being composed of potassium nitrate or refined saltpetre, instead of the sodium nitrate generally used as a filler. The explosives, which were first subjected to critical inspection and analysis at the factories by government officials, afterward in every instance met the severe tests imposed by the trying conditions due to the moist atmosphere that prevails on the isthmus.

To again meet the unusual conditions of the canal work, blasting fuse of special match construction insuring uniform resistance of the platinum wire bridges in the exploders were furnished by the Star Electric Fuse Works of Wilkesbarre, Pa. The advanced process of manufacture secured for this company the use of its exploder, while the superior make of batteries led to large requisitions for them for use in setting off charges of dynamite.

The batteries were made in such form that they were in a class by themselves. The magnets had shunt and series winding,

which no other manufacturer had attempted, and they were wound for amperage as well as voltage.

The waterproofing of the fuses or exploders made them well adapted for the very wet work encountered in so much of the canal's construction. The batteries held a surplus of current to overcome the leakage of current in wet working. The company supplied its product to the canal for several years, beginning with 1906.

Wire Rope at Panama

An important part of the mechanical equipment for digging the canal, one which impressed itself on every observer, was the number and size of the wire ropes in use.

It is known and taken as a matter of course that a wire rope is made of wires twisted together, and that these wires are in some way produced from bars of metal. It is not so well known that while the reduction of metal bars to slender threads was practiced by the oldest nations it has been only within the past century that wire has become important in the field of engineering.

A rope made of wires laid parallel with each other seems to have been used in Germany in the year 1820, but it was not until 1834 that wires were twisted together in something like the form of the modern wire rope. The advantages of such rope were not at once appreciated, for as late as 1840 wire rope was not used in America; few engineers had heard of it and probably no American had ever seen one.

In the year 1840 John A. Roebling, a young engineer who had a few years before left his native land of Germany, was employed in the construction of canals in western Pennsylvania. At that time the Pennsylvania Canal was an important waterway, the course of which across the state was intercepted by the Allegheny mountains. In order that navigation might be continued, inclined planes were built on the mountain sides. Canal boats were towed to the bottoms of these inclines, hauled up on one side of the mountain and lowered down the other side to the other part of the canal. Hemp ropes were used on the planes, and because of the weight of the boats these ropes necessarily were very bulky, and as a result of running along the planes they speedily became worn and frequently had to be replaced.

It occurred to Mr. Roebling that ropes made of wire might be used in place of the hemp ropes; that such ropes would be easier to handle, have greater strength, and give longer service. Roebling had never seen wire rope, but he had heard that such rope had been used in his native land and he could see no reason why rope used to advantage in Germany should not be used in America. So he bought a quantity of wire, built a rope walk on his farm and with the aid of his neighbors succeeded in twisting his wires into a rope. Permission was given for the equipment of a canal plane with this rope. Its success justified Roebling's confidence and led to the substitution of wire for hemp ropes on all the planes.

The Allegheny mountains did not present the only obstacle to the course of the canal. It was desirable that it should run to basins in Pittsburgh, but here the Allegheny River intervened. Mr. Roebling, impressed by the success of the wire ropes on the planes, proposed to extend the use of wire and by the aid of wire cables carry the Pennsylvania Canal across the river to the basins at Pittsburgh. To do this required the construction of an aqueduct suspended by cables across the river. This aqueduct was built in 1844-5, and notwithstanding many confident predictions that it would collapse under the weight of the water of the canal it proved amply strong and serviceable and brought added prestige to the wire rope maker.

It was therefore in connection with canal navigation and construction that the first attempts were made in America to use wire rope and to apply as a unit the strength of many wires. The manufacture of wire rope begun by John A. Roebling was continued by him during the remainder of his life, and since his death in 1869 has been

conducted by his sons, assisted during recent years by his grandsons.

So it happened that nearly three-quarters of a century after the pioneer rope maker watched his rope of twisted wire haul the boats of a canal, now long since abandoned, up steep mountain inclines, there was made at the works founded by him and under the direction of his descendants wire rope to be attached to powerful engines to haul boats through the wonderful locks of the canal at Panama. The wire in this rope is much stronger than would have been thought possible a few years ago. This is due to recent improvements in the treatment of steel from which the wire is drawn. The towing rope for the locks is one inch in diameter and is made of six strands of thirty-seven wires each twisted around a hemp center. A number of these ropes must be used at each lock. These were the last of a great variety of wire ropes made by the Roeblings for the Panama Canal.

When the digging of the canal began, the firm sent one of its wire rope experts to Panama to study conditions and obtain information which would assist in supplying appropriate wire ropes for different parts of the work. The wisdom of this move was fully justified by subsequent events, for in all over fifty contracts for wire rope, wire strand, and wire were placed with the Roebling Company by the Isthmian Canal Commission. The wire rope and strand called for by these contracts, if placed in a single line, would reach from Colon along the entire length of the canal to Panama and thence twenty miles outward on the Pacific. This, however, was far from being all the material of the kind used, as many lengths of wire rope were supplied those furnishing mechanical appliances of which wire rope is an auxiliary.

Roebling rope was used on cableways for controlling the movements of buckets and for cables along which the buckets ran in the transportation of materials across wide spans. It was used also on unloader plows, dragging them through flat cars piled high with earth and rock, the ploughs clearing the cars as the ropes pulled them along. Great steam shovels and dipper dredges which cleared the way for the canal were also equipped with Roebling wire rope. The rope used for the dipper dredges was in some instances over three inches in diameter, this being the largest wire rope ever used for a like purpose.

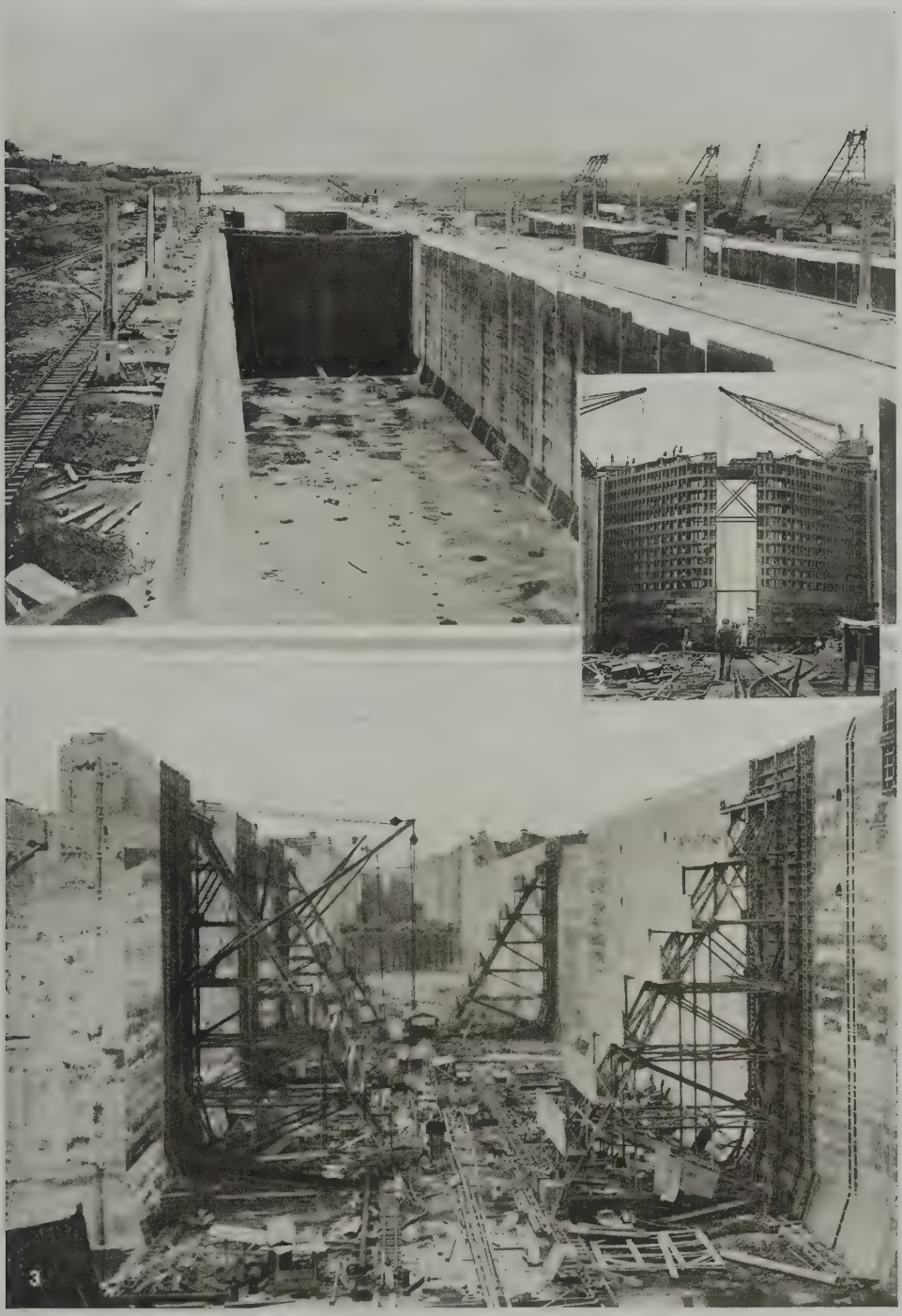
Three different constructions of wire rope were used for the Panama work. One was a rope made of six strands of nineteen wires each; another, eight strands of nineteen wires each, while the third was the same as that of the towing ropes at the locks, six strands of thirty-seven wires each. In each rope the strands were twisted around a hemp center. The hemp center of a wire rope does not provide much additional strength, but acts as a cushion to preserve the shape of the rope and helps to lubricate the wires.

The use of the different constructions was dependent on the conditions encountered. Where rope frequently struck the ground, or was run through earth, as was the case when used with unloader plows, it was necessary to have larger wires to resist abrasion, and wherever possible the rope with six strands of nineteen wires was used. Where resistance to abrasion was not so important and more flexibility was desired, rope with eight strands of nineteen wires or six strands of thirty-seven wires was used. An increase in the number of wires in a rope adds to the pliability of a given diameter, but naturally reduces the size of each wire.

What has been said of the high tensile strength of the towing lines at the locks is true of the other wire ropes shipped to Panama by the Roebling company. All Roebling ropes to be used under conditions where heavy stresses are common—conditions like the excavating, hauling, and towing of the Panama work—are made of wire drawn from steel the quality of which is proven by chemical and microscopic tests before being reduced to wire. Tests are made also of the wire before it is stranded



1. Lifting a girder with wire rope.
2. Wire rope pulling an unloading plough.
(Wire rope supplied by John A. Roebling's Sons Company, Trenton, N. J.)



LESCHEN WIRE ROPE AT WORK ON THE CANAL

1. Wire rope spans for the lock cableways.
2. Rope operating cranes at the lock gates.
3. Lifting material inside the locks. (Wire rope furnished by A. Leschen & Sons Rope Company of St. Louis, Mo.)

into rope, and full-size pieces of the finished rope are pulled apart on the great testing machines at the Roebling works. The result was that the strength and resisting power of every wire rope shipped from this works to the Canal Zone were known to be sufficient for the work to be done.

In addition to the wire ropes used in the work of excavating, hoisting, and loading, the Roebling company furnished many wire hawsers for towing. On the tug boats *Mariner*, *Porto Bello*, *Bohio*, *Gatun*, *M. E. Scully*, *Empire*, *Cocoli*, *La Boca*, *Miraflores*, and *De Lesseps*, and on a number of barges, the American Engineering Company installed automatic steam towing machines, and Roebling hawsers were selected by the commission to complete the equipment.

The towing machines are so constructed that they pay out and reel in the hawsers as the strains of the tow vary with the changing conditions of wind and tide. The tugs and barges were used for conveying material dredged to make the canal opening out to dumping grounds at Limon and Panama bays, and also for bringing in sand and rock. The towing on the Atlantic side was at times very hazardous during the season of "northers," when a heavy sea ran almost continuously and towing had to be done on the ocean, close to the coral-formed coast.

At one time three barges on the Atlantic were needed on the Pacific side of the isthmus. The distance in a straight line from the anchorage on the Atlantic side to Balboa on the Pacific was not more than fifty miles; but to overcome it required a voyage down the east coast, through the Straits of Magellan and up the west coast, in all more than 10,000 miles.

The tug *M. E. Scully*, later named the *Reliance*, with the barges in tow, left Cristobal on the morning of February 11, and arrived in Panama Bay, June 17, one hundred and twenty-six days being taken by the trip, of which eighty-six were actual steaming days.

During the first three days out, the weather was stormy, with great seas that kept the decks awash, and prevented any progress, while terrific strains were brought on the hawsers and towing machinery. However, these strains were not beyond the strength of the towing equipment, and the voyage was accomplished without accident of any kind. This ranks among the great feats of deep-sea towing, being surpassed only by the tow of the dry dock *Dewey* from the Chesapeake Bay to the Philippines, for which also Roebling wire hawsers were used.

The hawsers used for the Panama towing ranged from one inch to one and three-quarter inches in diameter and were composed of six strands of thirty-seven wires each twisted around a hemp center. They were heavily galvanized as a protection against rust.

It is interesting to note that in the Roebling mills, where the steel wire for the ropes was made, there was also drawn a large quantity of bronze wire to make the screens for protecting windows and porches against flies and mosquitoes. The screens were made by the New Jersey Wire Cloth Company, an allied Roebling concern, and the protection afforded by them aided materially in preserving the health of those employed on the canal work.

The importance of wire rope as a factor in the construction of the canal is evidenced by the fact that nearly all the great firms in the United States manufacturing this product contributed large quantities to the canal work, much of it being the specialized product of some particular firm.

The many early failures on this work were due largely to the fact that at the time of the various undertakings the necessary means for carrying on such a work had not been developed sufficiently to meet the many new conditions imposed by such a great enterprise. This is evidenced by the numerous relics of expensive machinery used in former attempts now being allowed to rust away in the places where they were discarded.

While every class and individual piece of equipment on the canal has played its important part, possibly wire rope has been more generally employed than any other one article on account of its diversified use. On the steam shovels and dredges it lifted the soil and rock and placed it upon cars and then unloaded them. On the cableways it handled practically all the material that makes up the mighty locks and dams. Its work is not finished with the canal, for it will be required for towing vessels through the locks, operating the gates, and other purposes.

About fifty years before the beginning of the canal by the United States, there was founded at St. Louis the A. Leschen & Sons Rope Company. The start of this concern was in a small way, but the principle of its foundation was to develop and produce material that would become a standard in its particular line; and by adhering to this principle, it was not only prepared to supply wire rope in large quantities that successfully performed the tasks imposed upon it by the canal work, but was also able to provide wire rope which has taken a prominent part on various undertakings that preceded the building of the Panama Canal, such as the great transcontinental railroads, Chicago Drainage Canal, Roosevelt Dam, Florida East Coast Railway, raising the *Maine*, and other notable enterprises.

During the early period of this company's existence, the best grade of wire rope produced was plow steel, so called because it was originally used for steam plowing—a class of work subjecting a rope to great strains and constant friction from dragging over earth and rock.

It soon became apparent to the Leschen company that plow steel rope was not capable of satisfactory service on many wire rope-using equipments. While it afforded considerable strength, it did not possess a sufficient amount of elasticity, toughness, and flexibility. It, therefore, became their aim to produce a rope that would meet all requirements.

After careful study and numerous experiments, a rope was developed by them that exacting and careful tests proved to combine all the necessary qualities in correct proportions for maximum wire rope service under severe usage. This grade of rope was trademarked under the name of "Hercules," and in order to designate it in appearance, the novel idea was originated of coloring one of its strands red.

Not satisfied with producing a rope of such high quality as "Hercules," constant improvements in construction were made by the Leschen company, and in addition to manufacturing the ordinary types of round strand rope, they produced ropes of the patent flattened strand construction, which on account of simple but correct mechanical principles affords great resistance to wear and is extremely strong and flexible.

Of the many different methods and means employed for excavating and handling material on the canal, the cableways possibly did a greater amount of this work than any other. It required more than an ordinary rope to give satisfactory service on these machines, for there were many severe conditions to be met. The speed at which they were operated was high; the loads heavy; and there were many bends around sheaves and guides.

It was on these cableways that the great efficiency of "Hercules" wire rope was demonstrated. It was here also that the years devoted to the study of wire rope construction were fully justified, for "Hercules" wire rope in the patent flattened strand construction was necessary to successfully do the work.

Another exacting use of wire rope was on the ballast unloaders. These machines removed the excavated material from flat cars by a plow drawn from one end of a train of cars to the other by means of a wire cable, usually one and one-half inches in diameter. When these ballast unloaders were furnished the canal commission, they were equipped with "Hercules" wire rope. Many renewal orders were also placed for "Hercules" rope for

this work. Altogether the total length of "Hercules" wire rope furnished for this one purpose alone would reach almost from one end of the canal to the other.

"Hercules" wire rope was also used on steam shovels, dredges, and derricks, both the patent flattened strand and round strand constructions being furnished, depending upon the existing conditions.

In addition to the "Hercules" rope furnished, large quantities of Leschen rope, including cast steel ropes, plow steel, Swedish iron, and tiller rope were furnished. This company was awarded annual contract No. 14 for furnishing wire rope from June, 1909, to June, 1910, which was one of the periods of greatest activity. Altogether approximately a million feet of Leschen wire rope took part in this great work, the greater portion of this being the red strand "Hercules," and much of it was ordered without competitive bids, due to its having demonstrated the economy of its use.

The firm of A. Leschen & Sons Rope Co. was established in 1857. Now the Leschen works cover over thirty-three acres, and Leschen products are distributed over the entire world, through six branch houses and by over one hundred agents. "Red Strand Hercules" is known wherever wire rope is used.

One of the first things the canal engineers discovered when they actually began to "make the dirt fly" was that ordinary tools and machinery were not built to withstand the strenuous and unusual conditions that prevailed at Panama. Great machines that had filled every requirement of similar work at home were found inadequate for the steady and unremitting strain of the canal construction, and had to be rebuilt on stronger lines.

An early discovery that gave concern to the engineers was the short life of the cables used on the soil unloaders.

These unloaders are the same as those used by railroads for unloading ballast. Their operation is very simple. A steel plow is dragged by wire cable from end to end of a string of flat cars, scraping off the dirt or ballast to one side as it goes. One and one-half-inch diameter cables were used for this purpose at Panama. Three or four hundred trains of sixteen and seventeen cars each were about all one cable could unload before breaking. The highest record was about 500 trains.

Early in 1909 Charles E. Bascom, of the Broderick & Bascom Rope Co., St. Louis, and E. P. Frederick, general superintendent of that company, went to Panama for the express purpose of finding out *why* the unloader cables broke so soon; also to remedy the trouble, if possible. The Panama officials encouraged manufacturers to visit the canal, and offered every help in studying conditions under which their products were employed in the big job. It was an excellent policy, and benefited both the canal engineers and the manufacturers.

Here is what Mr. Bascom and Mr. Frederick found when they investigated the conditions affecting the cables of the soil unloaders: The cars of the soil trains were packed high with earth and rock—not mere rubble, but huge boulders. Some weighed three or four tons. The wire cables were drawn over these great, sharp rocks while under a strain of from 90 to 100 tons. The friction actually caused the rocks to smoke, while deep grooves were worn in them. One of their own cables wore a groove ten inches deep in a rock in about six minutes.

Those were the conditions that had to be met, and met squarely by the cable that was to make a success in this particular work. It was a real problem, but Mr. Frederick was equal to it. His many years of experience in wire rope-making gave him a clue. His knowledge of wire rope enabled him to unravel the difficulty. He devised a rope of special construction—a rope within a rope. It is called Brobas Yellow Strand Wire Rope—Frederick Patent. This cable is a "compound" rope, but different in construction from ordinary compound ropes. It is "layed up" differently. In Brobas yellow strand the exterior and interior strands are so arranged

that all tendencies of the strands to chafe and cut on each other are practically eliminated. The life of the rope, compared with other compound ropes, is therefore much greater.

Because of the peculiar construction, this Brobas rope is able to withstand sudden shocks, heavy strains and severe bending, up to the ultimate breaking strain of "ordinary" constructed rope of equal size and quality, without affecting its elasticity. The actual breaking strain is twenty-five per cent. greater than that of "ordinary" constructed rope.

Another advantage of this construction is this: the strands of the inner core lying in the interstices of the outer strands tend greatly to prevent the wires of the outer rope from creeping.

Mr. Frederick's new cable idea appealed to the canal engineers, and one and one-half-inch cables of this type were made up. The wire, with slight modifications, was the same that is used in yellow strand of ordinary construction.

The unloading records made by these special cables exceeded all expectations. Instead of unloading 300 to 500 trains of sixteen and seventeen cars, 1,830 trains of seventeen and nineteen cars were unloaded; then 1,875 trains; then 2,010 trains—more than four times as many as had ever been unloaded before the advent of B. & B. compound yellow strand cables.

Here is a complete record of three cables mentioned above, made by the canal commission:

TEST NO. 98

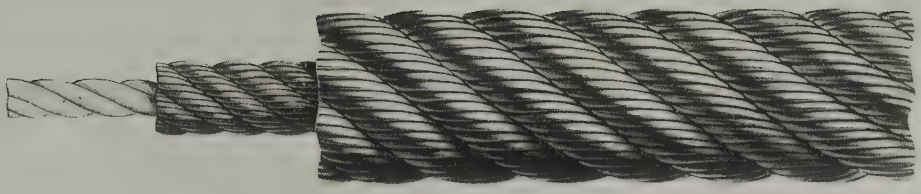
COMPARATIVE TEST OF CABLE ON LIDGERWOOD UNLOADERS ON THE CANAL ZONE CONDUCTED BY THE ISTHMIAN CANAL COMMISSION UNDER THE DIRECTION OF THE DEPARTMENT OF M. P. & M.
BRODERICK & BASCOM

Reel No. or Brand	Size of Cable	No. of Unloader	Date Applied	Date Removed	Time of Service Days	No. of Snatch Blocks Used	Place of Break	Total Trains Unloaded	Cable Cost per Train Unloaded
No. 1	1½"	32	4/12/09	5/5/10	388	333	8 CARS from Plow	1830 s	$0.218
No. 5	1½"	37	6/5/09	3/19/10	287	410	8 CARS from Plow	1875 s	$0.213
No. 3	1½"	38	6/11/09	11/3/10	510	310	8 CARS from Plow	2010 s	$0.199

Based on nineteen cars per train, this brings the cost of unloading each car to just a trifle over one cent In this connection the late Colonel D. D. Gaillard, who gave his life for the canal work and who was so signally honored by Congress, said, "Yellow Strand from Broderick & Bascom cable on Lidgerwood No. 46 was all right after plowing 1,870 trains. It will be noticed that the yellow paint is on strand after plowing off 35,530 cars, or in other words 296 miles of train. This makes a cost of $0.011 per car for cable."

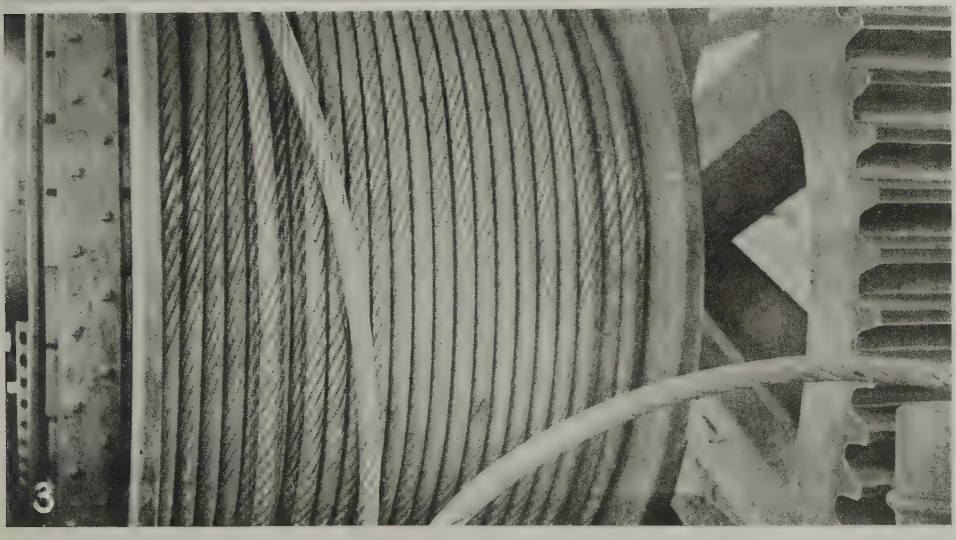
Nine B. & B. compound yellow strand cables averaged 1,388 trains per cable. All cables of both makes were the same diameter—one and one-half inch. As substantial proof that B. & B. compound yellow strand cables met the situation adequately, it might be mentioned that the government purchased over $25,000 worth of these ropes exclusively for ballast unloaders.

Yellow strand cables are made of a special high-grade steel wire, drawn in Europe to Broderick & Bascom's specifications. They import this wire and control its use in this country. This special wire has an actual tested tensile strength of 240,000 to 260,000 pounds per square inch. But the durability of this special yellow strand wire is due to something deeper than its great strength. It has



1





1. Wire Rope, core and weave.
2. The busy Cableway Towers at Gatun during construction.
3. Drum of wire rope.
(Supplied by the Broderick & Bascom Rope Company, St. Louis, Mo.)

a character all its own—a character inherited from the purest of Swedish ore and developed by painstaking manufacturing methods.

The ingot steel is made in England by the Siemen's Martin acid process which produces Sheffield steel. The ingots are rolled into bars and the bars drawn into wire by expert English wire drawers, and it makes wire that makes long-lived wire rope.

The wire rope is in general use for every purpose where great strength must be combined with flexibility and elasticity. The Broderick & Bascom Rope Co., whose main office is in St. Louis, Mo., have been making wire rope for over a third of a century. They have two factories—one in St. Louis, Mo., and the other in Seattle, Wash.

Among the manufacturers who furnished wire rope and insulated wire in the construction of the canal was the Hazard Manufacturing Company of Wilkesbarre, Pa., a firm established in 1848. The insulated wire department of this company was established in 1898, and has grown to be a very important factor in the company's business.

The products of the Hazard Manufacturing Company are known throughout the United States as of the finest quality, made to meet the real needs of purchasers and to give the most economical results in their use.

The wire ropes furnished the Isthmian Canal Commission were mainly of two constructions, one the regular hoisting rope construction composed of six strands of nineteen wires each with the best manila core as a cushion; the other what is known as extra flexible construction composed of eight strands of nineteen wires each with a manila core. The material entering into both constructions was the same, known as plow steel, with a breaking strain in the finished wire of some 115 to 120 gross tons per square inch, to meet the specifications of the commission.

The wire ropes furnished were of various sizes from one-half-inch diameter up to one-inch diameter inclusive. Test pieces were cut from all finished ropes as they were made up and tested by the inspector of the Isthmian Canal Commission to see that they were up to the required breaking strain. The specifications required by the commission were as follows:—

	Breaking Strain in Tons of 2,000 Pounds	
Diameter	6 Strands	8 Strands
½″	10	
⅝″	15½	14
¾″	23	20
⅞″	29	26
1″	38	

Sizes one-half and one inch were not made in the eight-strand construction.

This company also furnished the ballast unloader ropes which were required to do a most responsible work in connection with the rapid disposal of rock and dirt excavation. These ropes were one and one-half inches diameter, six strands of nineteen wires each, known as Seals patent or cable construction, and were made of the finest obtainable plow steel material drawn to the highest strains.

The insulated wire furnished the commission was for "house lighting," and was made in accordance with N. E. C. rules and requirements as adopted January 1, 1912. This company did not compete for the requirements of bare copper and electric conductors for use in the operation of the locks.

The Hazard Manufacturing Company in material furnished the Isthmian Canal Commission gave the same standard of excellence which it aims to maintain in all its products. Good service is the duty of every patriotic manufacturer in furnishing products to the United States Government, whether entering into supplies or permanent work. The open competition that was adopted by the commission brought about competitive conditions into which it was not always possible for this company to enter. It is a matter of pride and satisfaction, however, to its officers that the Hazard Manufacturing Company had some honorable part in connection with this work of national and world-wide importance.

The ordinary hoisting and other rope, so useful and important in general building and construction, was liberally used on the canal. Here again, American manufacturers had to meet unusual conditions.

Manila rope is always an important article in construction work, as upon its strength the safety of valuable property or life itself often depends, but at the same time it is one of those articles so easy to buy that its importance is seldom recognized. Usually when rope is needed a coil or two is bought at the nearest store and no more attention is given to it, unless it proves to be an inferior quality.

The location of the Panama Canal so far from the ordinary sources of supply made it necessary that all material (including rope) should be of a uniform and dependable quality. During the first few years all manila rope was purchased as the progress of the work demanded. Later it was found that it would be more desirable to have the rope purchased on the basis of an annual contract.

In 1910 the Columbian Rope Company of Auburn, N. Y., bid on these specifications and was successful in securing the award. The contract was for the fiscal year beginning June, 1910, and ending July 1, 1911. During this period the estimated requirements of the Isthmian Canal Commission for manila rope was about 1,000,000 pounds. Such a large amount of rope is difficult to comprehend, but the quantity can be better appreciated when it is known that if it were made into clothes line size there would be enough to make five continuous lines from New York to San Francisco, or in other words, over 15,000 miles of rope.

In the thousand and one different places where rope was used on the isthmus opportunities would arise for incorrect use or excessive strains, resulting in complaints. No more striking evidence of the uniformity and the high quality of "Columbian" manila rope has ever been offered than the one fact that during this entire period not a single complaint of any nature was registered against the wearing qualities of this rope.

The Columbian Rope Company was again awarded the contract for the entire manila rope requirements for the twelve months ending July 1, 1913, and during this period the rope gave just as good service as before.

When letting this contract the specifications of the Isthmian Canal Commission required that each size of rope should stand a given strain before breaking. The tests for this breaking strain consisted of taking samples of every fifth coil and breaking them on the Rhiele testing machine. During the time that the rope contract was placed with the Columbian Rope Company hundreds of breaks were made, and on each test "Columbian" rope equalled or exceeded the commission's requirements.

In reviewing this item of equipment for the canal's construction, the following points stand out prominently:

The peculiar excellence of "Columbian" rope for use in the climate of the isthmus; the uniformity of the product as shown by the absence of all complaints regarding the quality; the accurate system of inspection and grading of fibre that must be maintained to insure a product of such continuous uniformity; and the unusual facilities for quick manufacture and prompt shipment—no penalties ever having been charged against the company for delay in deliveries, except for penalty of a day or two due to the delay occasioned by the transportation company.

The Columbian Rope Company's plant is located in the city of Auburn, N. Y. It employs about 1,000 people and is the largest single industry in the city. The products consist of rope and commercial twines made from manila, sisal, flax, hemp and jute twines. The raw material is secured from many distant lands, as, for instance, manila fibre from the Philippine Islands; sisal fibre from Yucatan; flax from Russia; jute from India; and hemp from Italy, Russia or Kentucky. The product is principally sold in the United States, al-



Ninety-five-ton Bucyrus Shovels at work. The machine in the foreground for a long time held the canal record but was later beaten by another Bucyrus Machine. (The Bucyrus Company, South Milwaukee, Wis., also furnished two 15-yard dipper dredges, and is now constructing another, to cost $375,000, to handle material thrown into the canal by slides.)

though some goods are shipped to many distant countries, including Argentina, Brazil, South Africa, Norway and Asia Minor.

The officers of the company are: President, E. D. Metcalf; vice-president, T. M. Osborne; general manager, E. F. Metcalf; secretary and treasurer, F. M. Everett; assistant treasurer, H. G. Metcalf; general superintendent, C. A. Clark.

Among other cordage and rope accessories supplied for the canal were several cars of Old Colony braided sash cord, Hartz steel tackle blocks, manila rope, and other items of tackle and cordage shipped by George B. Carpenter & Co., of Chicago. This equipment was adopted because of its adaptability to any climate and uniform good quality and lowest price.

Dredging and Excavating Machinery

Those who were so fortunate as to have witnessed the work during the canal's construction will always retain the picture of the great steam shovels and dredges busily engaged in "making the dirt fly." The machines, more than human in their steadiness and precision, and impressive in their wonderful power, were easily among the most picturesque features of the canal work.

Dipper dredges, especially designed for the canal, were early set to work upon the slides in Culebra Cut. It is difficult, even for one familiar with this type of machinery, to comprehend their enormous size and power. Beside them, the discarded dredges of the French operations were pigmies.

The most graphic illustration of their size may be found in their fifteen cubic yard dippers, which could hold thirty-four men standing on a platform half way down the bowl. The boom of each dredge, with its machinery, weighed about 113,000 pounds, and was sixty-two feet long. The dipper handles were seventy-two feet long, and without the dipper weighed 81,000 pounds.

Before construction work was actively commenced on the isthmus, John F. Wallace, who was then chief engineer of the Isthmian Canal Commission, made his first tour of inspection along the proposed line of the canal, in August, 1904. In order to determine the most efficient method of doing the dry excavation he requested the Bucyrus Company, of South Milwaukee, Wis., to send a representative to the isthmus to discuss with him the types of machinery best fitted for the work.

On the 18th of the same month, a contract was signed with the Bucyrus Company for one seventy-ton and two ninety-five-ton steam shovels. This was followed in October with an order for five seventy-ton and six ninety-five-ton shovels. Subsequently, orders were placed with the Bucyrus Company until ultimately a total of thirty-two ninety-five-ton, thirty-five seventy-ton and ten forty-five-ton Bucyrus shovels were at work, making a total of seventy-seven out of a grand total of one hundred and one steam shovels engaged in the dry excavation of the canal. The ninety-five-ton shovels were equipped with five-yard dippers, the seventy-ton with three-yard, and the forty-five-ton with one-and-three-quarter-yard dippers.

Two fifteen-yard dipper dredges, the largest of their type ever constructed, were supplied by the Bucyrus Company, in addition to their dry excavation steam shovels, a railroad pile driver and three seventy-five-ton and one one-hundred-ton wrecking machines. The railroad pile driver was mainly used for work in connection with the Panama Railroad. The machine was self propelling, and was provided with a drop-hammer weighing 3,500 pounds. The wrecking cranes were used on both canal and railroad work.

The extraordinarily massive construction and enormous power of the dipper dredges attracted wide attention from engineers and technical experts, and were a favorite feature of interest to visitors.

It is not too much to say that without the help of the giant steam shovels and dredges the canal would yet be only in a preliminary stage of completion. An analysis of the records of the official performance of the steam shovels shows that

the Bucyrus shovels hold all records of output on the canal proper, where the most severe conditions were encountered. A ninety-five-ton Bucyrus excavated 4,823 cubic yards of material, classified as earth and rock, in five hours and twenty minutes. The same shovel, known in the official language of the commission as No. 213, holds the highest monthly record made in the canal prism, excavating in twenty-six days 70,290 cubic yards of material, or enough to fill a line of ordinary two-yard dump wagons reaching two hundred miles.

As the canal got deeper, the material encountered contained a higher percentage of rock. Down in the lowest cuts of the canal, where the most severe conditions were encountered and the most exacting service required, the giant Bucyrus machines dug stolidly until the last whistle echoed over the completed cuts.

During the earlier periods of excavation practically all of the material was removed by the larger types of shovels, but, as the work progressed, it became apparent that certain operations could be prosecuted more expeditiously and to better advantage by shovels of smaller make.

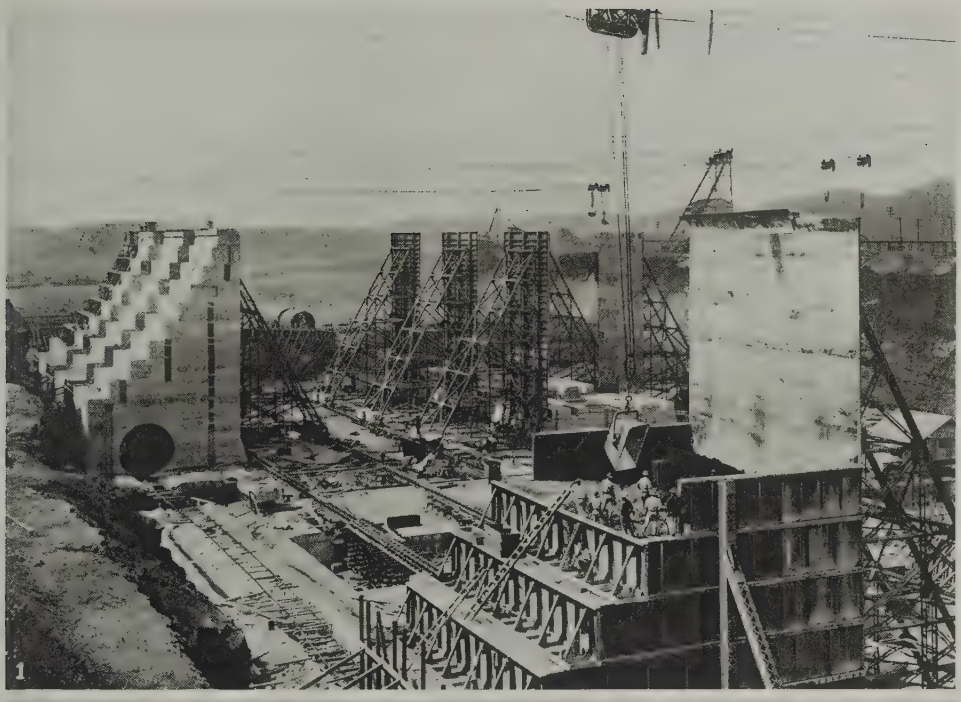
It was at this stage that the canal officials called for bids for the kind of shovel needed to meet the changed requirements. The Thew Automatic Shovel Company of Lorain, Ohio, had refrained from entering the field of competition earlier, largely because the entire output of its plant had been contracted for months ahead when the first bids were made. It answered the later appeal, however, and was awarded, over a large number of competitors, the contract calling for its thirty-two-ton steam shovel. This is a small, full-circle swing steam shovel, representing careful development under various practical tests, as well as the highest possible degree of perfection that the company could devise toward meeting the objects in view—basement excavating, loading material from rock piles, road and street grading, and the different classes of railroad, quarrying and other work in which the heavier excavator type of shovel cannot be used to advantage.

According to the reports of the men in charge of the equipment, the Thew shovels gave most satisfactory results during their entire period of use at the isthmus. As an example of the amount of work possible there may be quoted an eleven-day record recently made by one of the shovels—a duplicate of the Panama equipment—during which 2,605 cars were loaded with an aggregate of 14,942 cubic yards of material. Many other practical tests have shown that where the capacity desired does not exceed 1,000 to 1,500 cubic yards a day, the Thew shovel offers many features of decided advantage over any other similar article now being manufactured.

In addition to the dry excavation and dipper shovels and dredges, other types of dredges were prominent on the canal. One of the most important of these was the bucket "hopper dredge" *Corozal*, constructed by the William Simons Company, of Renfrew, Scotland, a firm distinguished by being one of the few foreign concerns to supply equipment for the canal. Before giving a description of the immense work done by this piece of dredging machinery a little of the history of the evolution in dredging machinery that has taken place within the last few years may be interesting to the reader.

The introduction of dredging machines in England is generally placed in the reign of Charles I, when several Dutch engineers went to that country to carry out some engineering projects. In the latter part of the 18th century important improvements were made in dredging appliances, particularly with operations on the Clyde, and further improvements were made a few years later in connection with the deepening of the Thames, and a dredging machine wrought with steam power was invented by Trevethick in 1806-7.

The application of steam power to dredging appliances culminated in 1861, in the construction of two hopper steamers by William Simons & Co., of Renfrew, for use





1. Lidgerwood cableway conveyors at work on side wall monolith, Gatun upper lock; cable rope furnished by A. Leschen & Sons Rope Co., St. Louis.
2. Lidgerwood unloaders sweeping the cars with Leschen's "Hercules" wire rope.
(Supplied by the Lidgerwood Manufacturing Company, New York.)

on dredging work on the Clyde. These were the first self-propelling vessels employed for transporting and depositing dredgings in deep water. The idea of employing steam power for this purpose was, at the time, looked upon with grave doubts, some regarding it as a piece of folly, and, as was customary in those days, it met with much opposition.

Time and actual accomplishment have amply demonstrated on the Clyde, Thames, and Mersey, and on the Panama Canal, that the substitution of "steam hoppers" for tugs, with their string of punts or scows, was a step in the right direction. This introduction of "steam hoppers" brought about other improvements. Among other suggestions was one that if it were possible to combine in one bottom all the distinctive features of the bucket ladder dredger and the steam hopper barge, many advantages, such as adaptability for working in confined spaces, economy in working, ability to work in exposed situations when it would be impossible for a barge to lie alongside a stationary dredger, etc., would be gained. The result was the invention by Mr. Brown of what is now known as the "hopper dredger." The first dredger of this type was the *Canada*, constructed by Messrs. Simons & Co., in 1872, to the order of the Dominion government. Improvements in detail followed in the course of time, as experience was gained in handling the new type of dredger.

The *Corozal*, used on the work of the Panama Canal, is the most powerful bucket "hopper" dredge yet constructed. It is a twin-screw vessel, built of steel, practically 269 feet in length. The steam generating plant consists of two marine cylindrical multitubular boilers, having a total heating surface of 4,044 square feet, and a combined grate area of 132 square feet. The boilers are constructed of mild steel suitable for a working steam pressure of 180 pounds per square inch, each boiler being capable of driving simultaneously one set of main engines together with all auxiliary engines. There are two main engines, which propel the vessel or run the dredging gear as required.

The air pumps are two independent vertical steam-driven pumps. The circulating pumps consist of two independent steam-driven centrifugal pumps. Other pumps for various parts of the work are supplied, and are operated independently of the main engines by steam direct from the boilers. The propellers are of cast iron secured to steel shafting driven through steel clutches from the main engines. The dredger is fitted with its own refrigerating and electric lighting plants.

The ladder upon which the continuous chain of large buckets revolves is built up of structural steel girders strongly braced laterally and vertically, and is 115 feet long, weighing 100 tons. With buckets and links and mountings on it the total weight of the ladder is 240 tons. The gear is so arranged that with a constant piston speed of the main engines three different speeds of the buckets can be obtained. This arrangement of the gearing permits the dredger successfully and economically to tackle very hard, medium and soft material. Two sizes of buckets are provided, one of fifty-four cubic feet for excavating in soft material, and one of thirty-five feet for digging in hard material. There are thirty-nine buckets in a chain.

For regulating and controlling the cut of the dredger enormous manœuvering winches are placed at bow and stern. These winches are of the most powerful description and were designed with special regard to the very hard nature of the dredging work to be done by the *Corozal* in the canal. The work for which the dredge was used was the digging of about four million cubic yards of hard material, rock, clay and boulders from the Pacific entrance of the canal between Balboa and Miraflores locks, excavation that could not be done by the ordinary ladder or dipper dredges, such as had been used by the French company, because of the character of the material and the depth at which it was found.

The *Corozal* has a center well ladder so that it can make its own flotation, that is, it can dig into a bank ahead, and when the ladder makes an angle of forty-five degrees with the vertical, excavation can be carried on at a depth of fifty feet. It was required by the canal engineers that the dredger should be capable of digging 1,200 cubic yards of soft material per hour at a depth of fifty feet.

The trip from the Clyde to Balboa by the dredger was a memorable voyage. The log showed a total of 12,064 miles covered in the journey, the actual sailing time consuming ninety-six days. The trip was made by way of the Strait of Magellan, and on arriving at its destination the dredger was ready for active service. The digging of the Panama Canal marks an era in dredging work in which the *Corozal* played a most important and successful part.

Disposal of Material from Excavations

From the foregoing record of the great forces at work in loosening the rocks and earth in the path marked out for the canal, it will be readily seen that one of the most difficult problems to be solved by the canal engineers was that of speedily disposing of the excavated material. With drills, powder, steam shovels and dredges creating an ever-increasing mass to be removed, all the resources of American ingenuity were called upon for a rapid means of getting the débris out of the way as fast as powder loosened it and the machine shovels scooped it up. The original plan of the canal builders seems to have contemplated the use either of the old French type of dump car or standard railroad cars of gondola or platform type. This was soon abandoned for more efficient equipment, and a number of American firms began to supply machinery and cars for the removal of excavated material that quickly solved this difficult feature of canal construction.

One hundred million cubic yards of rock and earth had to be disposed of from the Culebra Cut alone. This means a mass of material 100 feet wide, 100 feet deep, and more than fifty miles long. It means nearly 5,000,000 carloads. Places had to be chosen where this enormous mass of spoil could be deposited, railroad tracks provided to get the cars to and from the dumps, and finally a means for the rapid unloading of the train of cars. What is known in the mechanical and scientific world as "The Lidgerwood System" was among the means chosen for this important work, and thirty "Rapid Unloaders" were purchased.

The Lidgerwood system consists of trains of flat cars, with steel aprons bridging the spaces between the cars, a plow to sweep the load from the cars, a steel cable reaching the length of the train, and the "Rapid Unloader," a powerful winding engine to draw the plow through the train. A long train can be unloaded in five minutes. The unloader is placed on a flat car coupled to the locomotive, and takes steam from the locomotive boiler.

A train for unloading is made up with the locomotive and unloader attached to the head of the train, and with one of the regular Lidgerwood cars carrying the plow coupled to the rear. When the dump is reached the cable is attached to the plow, and the plow rapidly drawn along the cars, unloading earth and rock with a rapidity that is amazing.

In addition to its unloading system the Lidgerwood Company played an important part in another branch of the great work. Tourists and engineers visiting Gatun during construction time were fascinated in witnessing the operation of eight Lidgerwood cableways spanning the Gatun Locks. The supporting cables seemed like mere wire threads in the sky, and the loads appeared to fly. The visitor saw, first, the load being quickly lifted high in the air from a car on the bank; then go spinning along the wire threads, with great speed the carriage hovering a moment over the place of deposit, and finally the load low-



The bucket hopper dredge "Corozal" built for the canal work by William Simons & Company, of Renfrew, Scotland. This firm is distinguished by being practically the only foreign firm that had a large part in the canal construction.

ered and the contents of the bucket delivered into the wall. Two million cubic yards of concrete were placed in the walls by the cableways.

In the year 1904 the Western Wheeled Scraper Company of Aurora, Ill., submitted a tentative proposition to the Isthmian Canal Commission for twenty-four all-steel, double side-dump cars of twelve cubic yards capacity. This proposition was accepted with a view of giving the cars a thorough test in the actual work and under the conditions as they existed on the Isthmus.

These twenty-four cars were shipped to the canal in the early part of 1905 and on August 9, 1905, the first dirt was moved at Empire by American equipment in the Western air dump cars.

After these cars had been thoroughly tested and their value recognized by the engineers on the Isthmus, the commission ordered seventy-six additional, making 100 in all. This car was designed specifically for the hard service to which equipment was subjected on the canal and was a modification of the Western type of car as used in railroad construction in the States.

In December of the same year 200 more of these cars, all being twelve cubic yards capacity, were shipped. In the latter part of 1906 the commission, finding that it could use to advantage larger cars, ordered 300 Western side-dump cars of 18⅔ cubic yards capacity, which were shipped early in 1907. In 1909, 300 of the Western twelve-yard cars were shipped to the canal. There were also used some four-yard narrow-gauge cars at the Porto Bello crushing plant and some two-yard thirty-inch gauge cars.

All these cars were made exceptionally strong, and their record for standing up under the severe usage to which they were subjected shows the maintenance cost to have been extremely low. Most of them were used under steam shovel dippers of five cubic yards capacity. The impact of a mass of rock contained in a dipper of this size dropped from a considerable height is enormous. This made it necessary to use extra heavy material in the cars so as to avoid all liability of breakage.

The bed of the Western car is pivoted longitudinally in the center over the draft beams and will dump on either side; when dumping, the hinges, riveted to the center sill under the bed, rock on the pedestal castings which are riveted to the draft beams. One of the most important features of the car consists of the patented hinge connection between the bed and trucks. This hinge has two members riveted as above described to the bed and draft beams respectively. Between these members a bar of iron is hung perpendicularly, a horizontal pin passing through the lugs of the upper portion of the hinge and an eye in the perpendicular bar. This bar drops into a socket in the pedestal which forms the lower member of the hinge and which is riveted to the draft beams. Between the upper and lower members of the hinge is a steel wear plate. The bearing comes directly on the wear plate between the upper hinge casting and the pedestal, no strain whatever coming on the horizontal pin which holds the loose bar or hinge connection in place, and the bed and trucks are not fastened together in any way, but the bed rests loosely on the pedestal castings.

The arms which operate the side boards or doors of the Western cars are pivoted on the ends of the beds and at the ends of the side boards, and are operated by a toggle which is attached to the upper arm and to a central point at the end of the car bed. Immediately the bed is tilted, the toggle strikes a rest provided for the purpose, which lifts the door upward and outward from the load, giving the widest possible opening for discharge of the load.

The irons which operate the side doors are not attached to the truck, so that when the side chains are unlatched, the bed and truck are entirely separable. This separable feature of the upper hinge and ped-

estal is another point of considerable value. In the act of dumping, the bed is not held rigidly to the trucks, but is permitted to rise slightly from the pedestals at the moment of the shock, so that there is no tendency to lift the truck from the rails.

In the event of derailment and rolling down an embankment, the bed and truck automatically separate, causing less damage to the car and making much easier its replacement on the track.

The bearing on which the bed turns in dumping is of such construction and perfect adjustment as to make the dumping and bringing back of the bed to position much easier than on any other make of car, so that the saving in labor by use of the Western is very great.

The height of the Western is less than that of other cars. The dumping angle is forty-seven degrees. On account of the large opening for discharge and the acute dumping angle, anything that can be loaded into the cars will clear the side board in dumping, so that heavy rocks and bowlders or frozen earth in large masses can be easily handled.

The air dumping device used on these cars consists of a cylinder and a set of levers, chains, shafts, and cams for each side. The thrust of the piston rod acts on the lever, which transmits the motion to a shaft through a chain operating over a cam. On the same shaft are two other cams to which the dumping chains are attached, the upper ends of these chains being fastened to the outer angle sills of the bed. The action of the lever causes the shaft to rotate, drawing the bed down to the dumping angle. The return of the bed to carrying position is accomplished by similar action of the device on the opposite side of the car. The air used in dumping the car will serve to return the bed to upright position. The dumping and righting of the car are controlled by the engineer in his cab, operating a special four-way valve designed for this purpose.

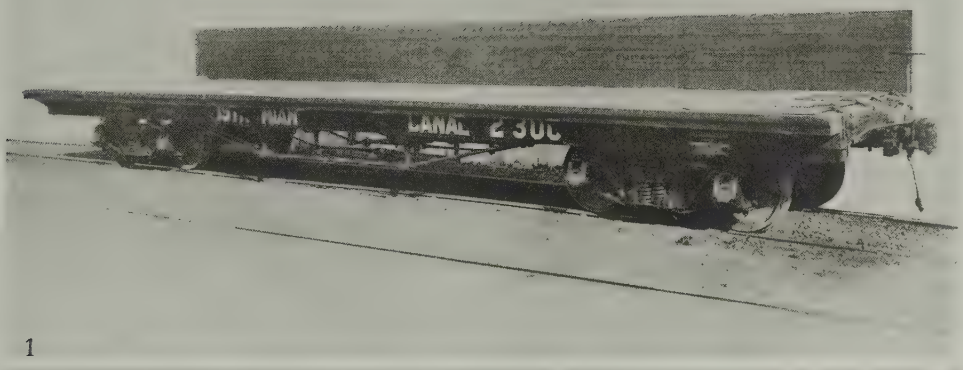
Added to the great saving in the operation of the cars are the fewer repairs required, due not only to their great strength but also to the fact that they stay on the tracks, thus avoiding heavy expenses through derailment and wrecks.

One of the most valuable characteristics is that of rapidity of operation. The dumping of the cars and the bringing back to the upright position require but a few seconds, so that it will be readily appreciated how very great was the importance of this equipment in the saving of time.

The Western dump cars made a remarkable record on the Isthmus, and it is safe to say that had it not been for their use, the cost of handling the material would have been greatly in excess of the actual amount expended.

This type of car has been used on all the gigantic earth-moving enterprises on the American continent within recent date. They have formed an important factor in the construction of practically all railroads in North America in recent years, in the building of the Keokuk Dam, the great Lackawanna Cut-off, the immense stripping operations on the Mesabe Iron Range in northern Minnesota, where more material has been handled than was taken out of the Panama Canal, on the Mississippi levees, in the excavation of the Welland Canal and the approaches to the Selkirk Tunnels in the Canadian Rockies, and other enterprises of more or less importance.

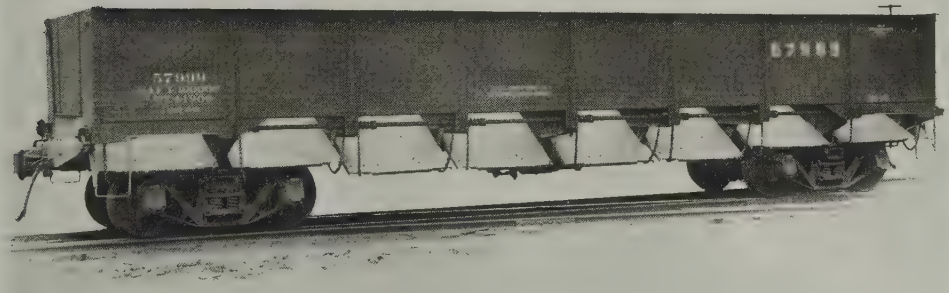
Active operations by the Pressed Steel Car Company (Western Steel Car & Foundry Company), of Pittsburgh, Pa., in the construction work at the Panama Canal began in 1907. At that time it built at its works in Anniston, Ala., a lot of 300 flat cars for the Isthmian Canal Commission. This contract was entered into and completed in fulfilment of an order originally taken out by another company, which was unable to make delivery, in consequence of which the commission called upon the Pressed Steel Car Company to furnish the required material.



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1. Wooden dirt car with steel sides.
2. Loading dump cars in Culebra Cut.
3. All-steel dump car.
   (Made by the Pressed Steel Car Co., Pittsburgh, Pa.)

The cars in question by no means represent the up-to-date steel construction equipment now being turned out by the Pressed Steel Car Company, and therefore poorly illustrate its more modern achievements in car building. However, they were in keeping with the specified requirements, and were built expressly to fill the demands made by the commission. They were of wood construction, having a capacity of 80,000 pounds each, and were built with removable side and side extension so as to be suitable for operation in connection with Lidgerwood unloaders. They were also equipped with a steel apron on one end to cover the space between the cars, as well as with arch bar trucks, and many other approved specialties for cars of this type.

While the cars furnished were, no doubt, in most respects as satisfactory to the commission as more up-to-date cars—at all events, they were what the commission desired—it may be said that the all-wood car is a thing of the past on American railroads. At present, flat cars are built with steel underframes, with either steel or wood floors as may be required. In the general improvement in steel car construction the Pressed Steel Car Company has kept to the front of the rapid advance that has characterized the industry of this country. Among the principal types which it builds at the present time are:

All-steel gondola cars, with high or low sides, and with or without drop doors or hoppers at the bottom, the latest model being so constructed that the drop doors dump the load at either side. When the doors are closed, this car can be used as an ordinary flat bottom car.

The composite gondola cars have steel underframes, while the floors, sides, and ends are of wood. They are used mainly for handling machinery and lengthy material.

The center dumping hopper cars are generally used for hauling coal, coke, and ore. These are built up to seventy-ton capacity, the triple and quadruple cars having a cubical capacity suitable for handling as much as fifty tons of coke.

In the construction of its box cars, the only wood used by the company is in the floors and lining. Many of these cars have large side doors and end doors, to facilitate the loading and unloading of automobiles.

The Pressed Steel Car Company is now building tank cars entirely of steel, the tanks being attached to the center sills at the center, and require no blocking at the ends of the tanks.

Another field of construction in which this company has made marked advance is in its passenger cars, as also in its mining cars. The superiority of steel over wood in both cases is too widely recognized to call for extended comment, especially in the former, where the use of the steel car so greatly reduces loss of life in wrecks, as well as destruction of the material itself through splintering and burning. The steel mining cars are also practically indestructible, and a less number is required to operate a mine or quarry of a given output.

In addition to the manufacture of the various kinds of cars enumerated, this company has a large business in repairs on cars, including the supplying of the various parts, as well as of trucks for engine tenders and cars.

The Pressed Steel Car Company began building steel cars in 1897, having been first in the field in a work that has since almost revolutionized the transportation methods of the country, as may be gathered from the foregoing description. The company now operates two plants in the Pittsburgh district, one at McKees Rocks and the other in the former city of Allegheny. A third plant, thoroughly equipped for building steel cars, is located at Hegewisch, Ill., near Chicago. The company has a capacity of 200 cars a day, and employs a force of more than 10,000 men when running full. The plants occupy a total area of 145 acres, of which sixty acres are covered with steel and stone buildings of mod-

ern construction. The average consumption of material is 40,000 tons of steel each month, of which 28,000 tons is steel plate, making the company the largest individual consumer of steel plate in the world.

The steel car has done much to improve and increase the carrying capacity of the railroads on which they are used. As late as 1907, a capacity of 100,000 pounds was considered by railroad men to meet the maximum that a freight car could carry. Steel freight cars are now being constructed for general use with capacities up to 140,000 pounds, showing an increase of forty per cent. in six years, and still heavier capacities up to ninety tons and more are being built at the present time.

In January, 1906, the Goodwin Car Company, William H. Taylor, president, with headquarters at 17 Battery Place, New York City, an Illinois office at 10 La Salle Street, in Chicago, and its own car building plant at Clearing, Ill., sent a number of its patent gravity dumping cars, of steel construction, to the Isthmus for service in the construction work on the canal.

The cars of this company were specially adapted, and proved fully equal to the severe service for which they were ordered, in that they combined all of the requisite features found in other dumping, ballasting and gondola cars, together with a number of additional devices that are unique in this particular make of car. One of its most important advantages is that it can be immediately diverted to many required services without alteration or change of parts. The load which it carries is discharged by its own gravity alone, on both sides or on either side, all in the center, or part on either side and part in the center, and it will distribute ballast in any position required without careening the car or moving the car body. This applies to practically every imaginable kind of load, whether tin plate or rail ends, broken stone or hot cinders, large rock or gravel, or any other dumpable materials. These cars are air-dumping, air-replacing, hand-dumping, and hand-replacing, all in one.

The Goodwin car is built entirely of steel plates and angles, and is fitted with malleable iron and steel castings. The capacity of the car is thirty to forty-five cubic yards, with a weight-carrying power limited only by size of journal and from 100,000 pounds upward. Through its new air replacing device, one man, without assistance, can close all of the doors and set the car ready for reloading. These cars are extensively used throughout the United States in railroad building.

Hydraulic Dredges

An important type of dredge used in the canal was the hydraulic, utilized to meet certain extraordinary conditions of wet excavation, where a machine of great power and capacity was needed. At a cost of $158,000 a twenty-inch hydraulic pipe line dredge, built by the Ellicott Machine Company, of Baltimore, Md., was purchased. This dredge had a capacity of excavating 750 cubic yards per hour. It required twenty days to tow the dredge from Baltimore to Colon.

The dredge was of the cutter type with a single sand pumping outfit, and the general dimensions were 150 feet over all, beam moulded forty feet, and extreme depth of hull ten feet and six inches. The hull was constructed throughout of steel, and was divided by four water-tight compartments. The steam plant consisted of four wet back Scotch marine boilers built for a working pressure of 200 pounds per square inch, operated with both oil and coal as fuel. The aggregate indicated capacity of the engines was 1,000 horsepower.

The pumping machinery consisted of a centrifugal pump of the side suction disc-lined type, constructed throughout of steel. It was so designed as to admit of the passage of sand, stones, or gravel without obstruction. The main pumping engine consisted of a three cylinder expansion vertical fore and aft condensing engine.

The material to be dredged, which consisted of coral, sand, and rock, had to be loosened or "agitated" before it could be pumped. For this purpose on the bow of the dredge was located a steel ladder of framework, carrying a revolving cutter, which was of the spiral type and constructed of steel. The depth of the cutting was regulated by raising and lowering the outer end of the ladder, which was capable of making a cut to a depth exceeding forty feet. The suction pipe was carried by the ladder and extended to the outer end where it passed inside of the revolving cutter. The "agitating" engine (it was a double condensing engine especially designed to bear the constant shocks and jars incident to the work) was mounted on the ladder.

The superstructure over the hull was of wood throughout and consisted of a house over the main deck covering all parts of the machinery. Above the main house, provisions were made for the living quarters of the officers and crew, which were specially designed for convenience and comfort, together with the pilot house. In the pilot house were located levers for operating all the machinery except the main engine, so that the operator had full control of the working of the various parts from this point. All the door and window openings of the living quarters were fitted with bronze screens and slatted blinds. Staterooms for the officers and sleeping quarters for the crew with appropriate mess rooms for each were provided.

The dredge was also fitted with an ice plant and an electric plant. The refrigerating plant was provided with ice pans for making ice for drinking water and to cool the refrigerator. By the electric plant the whole interior of the dredge was lighted. It also carried a powerful searchlight.

It is obvious that the canal could not have been dug without the expenditure of many years of time and the labor of hundreds of thousands of diggers had not the most improved dredges operated by the latest machinery been employed.

The equipment of a first-class modern dredge does not end with the machinery necessary to move the dredge from place to place, but must include pumps of great capacity and endurance, and modern experience has demonstrated that the centrifugal pump is the kind best adapted for dredging purposes. In fact the principal part of the equipment of a modern dredge is the centrifugal pump for handling solid material with water. The dredges used in the canal work were equipped with centrifugal pumps manufactured by the Morris Machine Works of Baldwinsville, N. Y.

From the dredging pump a suction pipe leads to the bottom of the river or canal, or other place from which the material is to be pumped. The pump produces a high velocity in the suction pipe, sufficient to draw into the pipe the material, pass the material through the pump, and then deliver it through a pipe line at the point desired. Where hard material is found, revolving cutters are employed for cutting the material before it is drawn into the suction pipe.

A number of the Morris pumps were used in the canal work, one of them being of capacity enough to deliver 300 cubic yards of material per hour, through 1,000 feet of pipe line, while another delivered about 400 cubic yards through a pipe line 4,000 feet in length. One system, consisting of three hydraulic dredging pumps, installed by the Morris Company in 1909 and used in making the Gatun fill, was of peculiar interest. In this work the material had to be elevated as high as eighty feet, through pipe lines varying in length from 6,000 to 8,000 feet. One pump was placed on the hydraulic dredge floating on the water. This pump took the material from the bottom and delivered through the pump and a pipe line into the suction of a second pump, known as a "booster." This booster, in turn, delivered it to another, so that with all these pumps operating in series, one boosting the other, the material was delivered to the elevation desired.

The Morris centrifugal pumps were also brought into play as an aid to sanitation. In a climate such as that of Panama drainage, sewage, and other like refuse cannot be permitted to remain, but must be disposed of in a way to prevent danger to human health and life. Four Morris pumps were used for the purpose of taking drainage and sewage, as collected in pits, and pumping it away to points of safety. These pumps are driven by electric motors, and some of them are of automatic operation.

The Morris Company is the oldest concern in this country building centrifugal pumps, and its experience has covered all classes of this machinery.

When the Canal Commission abandoned its original design of building two dams and two locks at La Boca, near the Pacific terminal, it made necessary the dredging of a sea-level canal from La Boca back to Miraflores. This brought into play the installation of engines and pumps of the International Steam Pump Company, of New York. A vast amount of material was to be removed and it was necessary for the commission to secure the most adequate type of machinery to accomplish the purpose in the shortest time.

The contract called for complete machinery for a central pumping station of four units, each consisting of one pressure pumping engine, boilers, one dredging pump, one motor, piping and hydraulic monitors, etc. Speed was one of the considerations, and the contract of the International was to deliver the complete plant in 200 days. Such was the capacity of the company to fill all contracts that all the apparatus was delivered in much less time than the contract specified.

The dredging pumps were considered the most powerful of their kind, and were intended to do the work assigned them in one lift of ninety-five feet. The areas to be excavated and filled by means of the equipment installed by the International Company were eight feet above mean tide, and the average depth to be excavated was thirty-five feet. The material to be handled was dark loam, containing fifteen per cent. sand, with a mixture of gravel weighing as much as seventy-five pounds per cubic foot. In some parts of the areas having sand and clay, stones as large as twelve inches in diameter were found weighing ninety pounds per cubic foot, and equal to twenty or twenty-five per cent. of the material in suspension.

The method of operation was to sink the dredging pumps by stages in the prism to be excavated, until rock was reached, the sedimentary material being mined with the monitors, and sluiced by the dredging pumps. For mining and sluicing, salt water was used through all the pumps. The available power was 3,000 electrical H. P. The plant was designed on this basis for operating the dredging pump motors. The pumping plant had a capacity of 30,000 gallons per minute, pumping the same through 3,600 feet of main pipe, and 500 feet of branch lines.

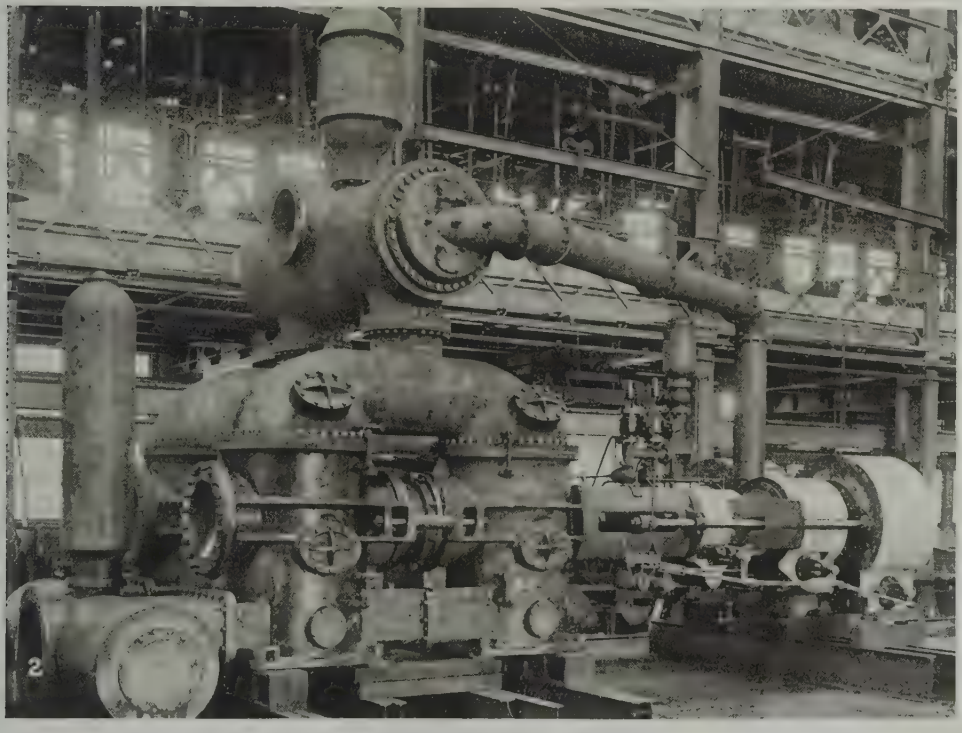
The central pumping station consisted of four units so constructed that they could be operated singly or in multiple, with any or all boilers. The engines took their water from the Rio Grande, having a variation of tide plus ten feet and minus the same distance. The equipment included a complete condensing system, oil and coal burning furnaces and special exhausters for taking care of the priming of the dredging pumps. The fourth or extra dredging pump was used for the excavation of more than 1,000,000 cubic yards of material, delivering the same to a hydraulic dam west of Miraflores locks, making a total lift of ninety-five feet.

The commission made many attempts to remove the vast amount of soft silt, earth, clay, and hard rocks by the use of dredges, and was forced to the conclusion that this material could not be economically handled in any other way than by the hydraulic method; hence came the contract with the International Steam Pump Company. It is one of the wonders of the canal construction that vast amounts of earth, silt, sand, and other materials were lifted from the



1. Hydraulic pipe line dredge.
2. Dredge spuds and dipper handles for the Panama Canal.
(Furnished by the Ellicott Machine Company of Baltimore, Md.)





1. Hydraulic excavation at the canal under pressure from Worthington pumps.
2. One of the giant triple expansion steam pumps used on the canal.
(Supplied by the International Steam Pump Company of New York.)

bed in which they had reposed for countless ages, and pumped, as if water, through thousands of feet of pipe and lifted to a height of nearly one hundred feet and there delivered at the will of the operator. This pumping process shortened the time of construction many months over what would have been required by the old system. A pump capable of handling 300 cubic yards of solid matter per hour almost staggers belief, yet the International Company had four such pumps at work on the canal.

In the excavation work, especially for deep foundations, wells, and for caissons, vast amounts of gravel and sand had to be taken out. To expedite this work sand pumps were employed, the Nye new model high-pressure pump being the one selected. These pumps were built by the Nye Steam Pump and Machinery Company, of Chicago, Ill. The pump is a small, compact machine designed especially for mining, railroad, draining, irrigation, cofferdam and well sinking work. The pump creates a very high vacuum, thus being able to lift water to a great height. One of the smaller size, requiring a space of only twenty inches square for installation, is capable of delivering water to a height of one hundred and fifty feet. The pumps used on the canal for sand pumping were capable of pumping seventy tons of sand per hour. Thus with a small expenditure of steam, 700 tons of sand could be pumped from an excavation in a day of ten hours. One of the advantages of these pumps for the purposes of the canal construction was that they could be worked suspended from a beam, or when placed upon a stand.

The earth fills and embankments of the canal were rolled in layers with Buffalo Pitts special embankment rollers, manufactured by the Buffalo Steam Roller Company, of Buffalo. These machines were so constructed that the corrugations could be removed from the rolls and the machines used for building streets and highways in the Canal Zone.

Buffalo Pitts rollers were selected because they are the result of twenty years' development of this machine by this company and have an unequaled record for efficiency and durability. Their record in the service of the various departments of the United States government and the government of the Philippine Islands was carefully scrutinized by the purchasing officials, and was found to justify their selection, regardless of the fact that they were somewhat more expensive than other rollers obtainable.

Another feature of these machines that recommended them to the engineers was the peculiarity of their construction, which enabled them to be utilized as hauling engines for drawing graders and wagon trains of road building or other material, over routes where it was impracticable to lay a temporary railway.

Construction Equipment

In the construction work of the Panama Canal the immense amount of heavy material to be handled made necessary the use of modern locomotive cranes. The principal cranes selected for the canal work were manufactured by the Browning Engineering Company, of Cleveland, Ohio. These locomotive cranes were self-propelling, and could rotate and hoist either independently or simultaneously. They were capable of lifting from one to 100 tons, and were fitted with booms 100 feet in length. They not only hoisted great stones and immense blocks of iron and heavy pieces of timber to their proper places in the work, but were also employed in digging; using, for this work, what is technically known as the "orange peel bucket." Blocks of stone and structural iron weighing many tons were handled with the greatest ease, some of them being hoisted to a height of nearly 100 feet.

Among the manufacturers who furnished machinery designed to expedite heavy work on the canal was the Brown Hoisting Machinery Company, of Cleveland, Ohio, designer and maker of patent automatic hoisting and conveying appliances.

In the autumn of 1905 this company shipped to the Isthmus one five-ton Brownhoist fast plant unloader and one five-ton cantilever crane. These machines were used on the docks at Cristobal. The unloader was used for unloading coal from the barges and transferring it to the railroad cars and the storage pile, and continued its work after the completion of the canal.

The unloader is equipped with a raisable apron 67½ feet long, which extends out over the boat, and at the rear of the unloader there is a cantilever extension of eighty feet. The Brownhoist trolley travels on the runway the entire length of the apron and cantilever extension. With this machine the company furnished a seventy cubic-foot Brownhoist coal grab bucket and four Brownhoist tubs. The grab bucket is suspended from the trolley, decends into the hold of the boat, automatically picks up its load, and carries it back to the storage pile or to the sixty-ton bin placed on the machine, from which the coal is dumped into the railroad cars. The tubs are used in cleaning up when the coal is to be shoveled by hand.

The unloader travels along the face of the dock with a speed of seventy-five feet a minute. It is steam operated, the boiler and engine house being placed on the pier. The trolley travels in its runway from 1,000 to 1,200 feet a minute, and has a hoisting speed of 500 to 600 feet a minute.

The cantilever crane was used for unloading general merchandise. It consisted of a steam operated pier running upon two tracks of thirty-seven-foot gauge, and had a cantilever extension on each side of 153 feet, one extension being out over the boats. This was also provided with a runway for a Brownhoist trolley, the entire trolley travel being 343 feet. With this appliance, heavy merchandise of all kinds was unloaded from the boats and deposited on railroad cars or a storage platform. These cantilever cranes were originally constructed for work on the Chicago Drainage Canal, and were the first of their kind in the world.

Brownhoist locomotive cranes for handling sand, crushed stone, coal, machinery, large block stone and other miscellaneous material were used in large numbers in the work on the Isthmus. These cranes were of fifteen to twenty-ton capacity. Brownhoist grab buckets of various capacities were used on the Lidgerwood cableways for handling crushed stone and other materials. Some remarkable records were made by the buckets in this work, and the appliances of this company, designed particularly to speed the handling of material of all kinds, counted heavily in the rapid completion of Uncle Sam's task at Panama.

The fact that on completion, all the power required for the operation of the canal as a whole was to be electrical, generated by water power from the spillways, gave to the selection of boilers to be used during construction—for the generation of steam required as power for various purposes connected with the construction work—an aspect essentially different from that ordinarily found in a work of such magnitude.

The numerous plants erected for construction work had to be considered as being of a temporary character. Further, a number of the plants had to be moved from point to point as the work of construction progressed, which made it advisable to utilize small and inexpensive boiler units. The result of such conditions was the installation of cylindrical, or return tubular, boilers in the greater number of the smaller plants.

In certain of the plants, however, which could be considered of more than a temporary character, that is, plants designed to operate several years, the added efficiency and general service of the water tube boiler was considered desirable despite the greater first cost. In plants of this kind boilers of the Babcock and Wilcox Company's manufacture were installed.

A number of these boilers were used, the first being installed at Panama in 1906 for the Union Oil Company. This company furnished the government with oil for a

number of its plants, all the way across the Isthmus. Oil was brought from California in tank steamers and distributed to various points by pipe lines.

In 1907 the Babcock and Wilcox Company installed two boilers, rated at 500 horsepower each, for the Isthmian Canal Commission at the Balboa compressor plant. These boilers supplied steam for two air compressors, and for a small electric lighting load. Two years later two more of these Stirling boilers were installed for the commission at the Porto Bello power plant, where the steam generated was used mainly for stone crushing.

The same year four Babcock and Wilcox boilers were installed in the Central pumping station for hydraulic excavation and sluicing. This plant was designed to take care of the dredging and pumping work from San Miguel to the Pacific. This contract was awarded because of the superior merit of the steel-cased semi-marine type of boilers which were sold under a rigid guarantee of efficiency. The steel-cased feature of this boiler played an important part in its selection by the government officials. Much trouble had been experienced with boiler-setting brickwork, because of the blasting over the whole length of the canal. The blasts were very heavy and it was almost impossible to keep boiler settings in place. As brick on the Isthmus cost in the neighborhood of $100 a thousand laid, the upkeep of the ordinary boiler settings was excessive. The steel casings of the boilers installed at this plant did away almost entirely with this difficulty. Another interesting feature of these boilers is the duplex furnace. By this arrangement either oil or coal can be used as fuel. The boilers installed at the Central pumping station were of wrought steel construction throughout, and nominally rated at 2,100 horsepower.

Among the contractors for permanent machinery to be used in operating the canal was the D'Olier Engineering Company, of Philadelphia. The entire boiler plant equipment for the power house at both Gatun and Miraflores was furnished by this firm, and was installed by them. Each plant contains 600 horsepower, horizontally inclined, water tube boilers. The boilers are set in batteries of two, and have steel casings instead of the usual brick setting. They were built for 205 pounds absolute pressure, and a superheat of 150 degrees Fahrenheit.

Each boiler is equipped with shaking grates for the use of coal by hand firing and also with a complete system of oil burners, for the use of California fuel oil. The smoke flue is of steel, lined inside with a two-inch non-conducting lining. Each plant is equipped with a motor driven and a steam driven induced draft exhaust fan for drawing the gases through the boilers and sending them up the chimney. The arrangement of the dampers is such that either the motor driven or the steam driven fan may be used.

The contracts of this company also included the induced draft equipment, piping, boiler feed pumps, feed water heaters, and other boiler rooms auxiliaries, all of which were installed by the company. The piping system is very complete and consists of the highest grade of pipe and fittings. The high pressure steam pipe is extra heavy, with steel flanges welded on, long bend connections being used. The fittings are of cast steel and the valves are made with cast steel bodies, bronze fitted. The high pressure piping is covered with a magnesia covering two inches thick. Hot water meters are provided for measuring the amount of water supplied to the boilers. The cost to the government for the equipment furnished by the D'Olier Company was $175,000. All the safety appliances known to modern science were used both in the construction and installation of the two power plants, and to secure the greatest efficiency.

As speed in the completion of the great work was an important feature in the calculations of the Canal Commission it was sought, even in the smallest appliances to the machinery, to secure the appliance

best adapted to the work it would be called upon to perform, and under the severe climatic conditions prevailing on the Isthmus. Many boilers were to be used in various parts of the work, and it was sought to have every appliance necessary for continuous work of the most complete kind. In looking for an injector for supplying the boilers with water, the choice fell on that manufactured by the Penberthy Injector Company, of Detroit, Mich. The superiority of this injector was its thorough automatic qualities, simple construction, and durability, operating with equal efficiency in any location or climate. The injectors excel in grading the amount of water delivered to the boilers, and lift water vertically twenty-three feet.

Keeler water tube boilers, manufactured by the E. Keeler Company, of Williamsport, Pa., were and are used at several points on the Canal Zone. In connection with the Gatun and Miraflores handling plants for the Gatun and Miraflores locks, these boilers were put through a series of rigid tests in which they made a remarkable showing.

The Keeler water tube boilers include an unusually complete combination of features. They are designed to secure simplicity and durability, together with the highest safety and economy. The boiler consists of one or more steam and water drums to which are securely riveted a front and rear water leg or header. The tubes are expanded into these headers in straight horizontal and staggered vertical rows with an inclination of one inch to a foot. The drum is horizontal, providing a maximum steam disengaging surface. The steam outlet is from the center of the drum.

Vertical baffle walls of a special grade of fire brick with a backing of cast iron direct the gases three times through the bank of tubes. The tubes are staggered and the gases move at right angles to them, thus being continually divided and reunited, and brought into intimate contact with the tube surfaces. Horizontal baffles are provided if required by special conditions, and other special arrangements of baffle walls are made when desirable. Wrought steel is used for every part of these boilers under pressure, and the highest class of skill and material is used in their construction.

Prominent among the power plants in connection with the construction work of the canal were the batteries of Robb boilers built by the Robb Mumford Boiler Company, at South Framingham, Mass., now owned and operated by the International Engineering Works of the United States and Canada. For the machine shop and air compressor plant at Gorgona, twenty-four large Robb boilers were built at the South Framingham plant. These boilers were set in batteries of six each, and each battery formed a unit, consisting of six boilers discharging into a horizontal flue which had provision for cutting out any boilers for cleansing, and thence into a self-supporting steel stack 100 feet high and seven feet in diameter. The boilers were of the standard horizontal return tube type, each eighty-four inches in diameter and nineteen feet ten inches in length. The Robb boilers are constructed according to the rules formulated by the Massachusetts Board of Boiler Rules, the most rigid requirements of any State in the Union.

The question of water for use in running the hundreds of boilers required on the canal work was one of the greatest importance. It was well known that the water on the Isthmus is particularly bad for boiler purposes, and to enable the engineers to succeed in procuring the proper efficiency from their boilers, it was necessary to use chemicals to properly neutralize the water. The government looked about for the best material obtainable for the purpose, and adopted the chemicals of the Bird-Archer Company, of New York, purchasing thousands of pounds to be used in the marine, stationary, and locomotive equipment from the Atlantic to the Pacific.

The materials, made in liquid and powdered form for stationary purposes (accord-





1. Shipping D'Olier boiler plant equipment to the canal.
2. The boilers installed at Miraflores power plant.
(D'Olier Engineering Company, Philadelphia, Pa.)

ing to analysis of water), in extract and solid form (the latter in zinc containers) for marine purposes, and a new material in solid form in sticks one-inch square and nineteen inches long, known as polarized mercury for locomotives, are as effective in their way for locomotive use as the canal will be for shipping.

In supplying a compound suitable for the conditions existing along the great waterway between the Atlantic and Pacific, owing to the many different conditions arising from the vast difference in scale-forming salts found in waters, it was necessary to consider both chemical and metallurgical conditions.

It being almost impossible to secure analyses of the different waters, there being so many, it was necessary to make a compound in extract form, combining along with chemical reaction, an addition of polarized quicksilver made under special process known only to the Bird-Archer Company, and covered by letters patent.

Owing to the use of different types of boilers, working under different conditions, it was necessary to depend largely upon mechanical action of the mercury in throwing off scale and preventing the formation of new scale, and also in the stopping and prevention of any galvanic or corrosive action which might arise from acidity in the water, or through the negative and positive action of metals, one against another, under heat and pressure.

The Bird-Archer Company supplied a very large quantity of these special chemicals, which proved to be the most efficient of any boiler chemical ever used. It was also necessary to put up this extract, on account of the tropical conditions, in a special form to allow for expansion, a condition not found in the colder climates.

The Bird-Archer Company manufactures special chemicals for locomotive, marine, and stationary boilers. It has in its employ the most skilled officials, in its chemical, metallurgical and engineering departments, and has among its engineer corps some of the best known master mechanics, chief engineers from the marine service, and superintending engineers in stationary lines. It is now the largest manufacturer of boiler chemicals in the world, having a trade with nearly every country, and supplies at least ninety per cent. of the chemicals used by the marine trade in the United States.

For over thirty years the Ball Engine Company, of Erie, Pa., has been exclusively engaged in the manufacture of high speed steam engines, and it was but natural that it should have an important part in the work of furnishing engines for use in the construction of the Panama Canal.

Seven Ball engines were used in connection with the work on the canal. The combined power of these engines amounted to 800 K.W. in direct connected electric generator units, and 900 horsepower in rope drives. The largest unit was of the Cross Compound Corliss type, operating at 150 R.P.M. and driving a sixty-cycle Alternator of 400 K.W. capacity. The other units were of the tandem compound type, equipped with Sweet balanced valves.

All of these engines were of the side crank construction, which has been adopted by this company because of its superior adaptation to the conditions met in service. The construction eliminates the necessity for three bearings in engines direct connected to generators, and avoids the undesirable feature of an overhanging wheel, which is particularly objectionable in the case of belt or rope drives, and in alternating current work.

The engines furnished for service in the Canal Zone were of standard construction throughout, and represent the result of years of constant study and care in an effort to produce a machine superior to all others of its kind.

The single valve engines are equipped with a flat balanced valve, having a minimum amount of clearance. The valve, valve seat, and pressure plate are finished to a high degree of accuracy, permitting the valve to work freely, but being steam tight. Means are provided by which the

valve may be readily adjusted to take up any wear that may occur. This is accomplished with a simple micrometer adjustment which allows the pressure plate to be minutely adjusted without removing the valve chest cover. This device is used exclusively on Ball engines.

On the Ball non-releasing gear Corliss engines the non-detaching valve gear is enclosed in a tight case which is partly filled with oil. This ingenius device makes possible a high speed engine of the genuine Corliss type because it keeps the valves completely at rest for more than one half the stroke, when the pressure on the valve is very much unbalanced, and when movement is detrimental.

In the latter part of 1907, the canal officials awarded to the Buckeye Engine Company, of Salem, Ohio, a contract for supplying one of its high-grade automatic steam engines, at a cost of $3,245, for work at the Isthmus. The award was based on the well-known merits of the machinery manufactured by this company, the government having previously purchased a number of its engines for use in construction work at other points.

The engine furnished was of the latest improved type as built by the company. It was of exceptional weight and strength, and so constructed as to insure the greatest possible durability and the most perfect adjustment of all its parts. Through its perfectly fitting valves ample travel at all adjustments was secured, thus eliminating untrue wear. The governor, being of the shaft type, is secured to the engine shaft, driving valves through an eccentric rod, rock shaft, and valve stem as positively as the main shaft is driven. This type gives the closest regulation under all conditions, and cannot become detached and wreck the engine. The Buckeye Engine Company has built more than 6,000 of these machines, besides being engaged in the manufacture of gas engines, and its latest product, the "Buckeye-mobile." This is a remarkably efficient engine and boiler unit for the effective utilization of superheated steam, a modification of the German type of locomobile, developed and adapted to American conditions.

One of the firms whose products were interwoven with many phases of the canal work was the Abendroth and Root Manufacturing Company, with its main offices and works at Newburgh, N. Y. This company, which manufactures the Root spiral riveted pipe, machinery and foundry supplies, plate metal construction, Root sectional water tube boilers and other like equipment, has been established since 1867, and its products were known in Central and South America long before canal construction was undertaken.

Many years ago, the company's pipes were used in installing the water pipe line at Tegucigalpa, Honduras, the line being over twelve miles long, with its head 2,000 feet above the city. An interesting illustration of the difficulties of shipments to this territory before the completion of the canal is shown by the roundabout way in which this pipe reached its destination. It was shipped by steamer from New York to the Isthmus of Panama, transferred to the railroad across the Isthmus, then on a steamer again up the coast to Amapala, and finally by barges to the mainland. It was then carried in carts ninety miles to Tegucigalpa.

With the completion of the canal, such a shipment could now be carried direct from New York to Amapala, and with the impetus given commerce, harbor and interior improvements by the example set by the United States at Panama, shipments to these remote destinations will meet few of the difficulties of years gone by.

Despite its rough journey, this pipe reached its destination in perfect condition, and a report fifteen years after it was laid down showed that it was working as perfectly as when the water was first turned in. The only damage the pipe sustained in that period was when it was twice cut during revolutions, but a length or two of new pipe soon made the whole as good as new.

Several miles of this company's asphalted



One of the great Brownhoist Cantilever Cranes at work in the Chicago Drainage Canal. Their efficiency there led to their extensive use on the Panama Canal.
(Supplied by the Brown Hoisting Machine Company, Cleveland, Ohio.)

spiral riveted pipe was used for hydraulic excavation work on the Pacific division of the canal, together with two of its hydraulic giants. On other portions of the canal, miles of pipe ranging from eight inches to twenty-six inches were used for exhaust steam, compressed air and water supply lines. The pipe was found suitable for all phases of the work where such piping was needed because of its light weight, great strength, and simplicity of connections.

A number of the Root water tube boilers manufactured by this company were purchased for power purposes at the canal. These boilers have a superior circulation that permits the highest degree of maximum fuel economy, easy steam qualities, low cost of repair and large capacity for overload.

The pipe furnished the canal by this company was made by its specially designed machinery, and coated inside and out by its special asphaltum composition or galvanizing process, insuring the longest possible life to the material by protecting it from corrosion. The spiral riveted construction gives the pipe a continuous helical rib, giving it great strength and rigidity combined with corresponding lightness in weight. It furnished one of the best examples of the thoroughness of American manufacture in the list of general equipment used in the canal's construction.

In the preparation for actual construction of the canal, to say nothing of construction work, large quantities of wrought steel and iron pipe were required. The water and sewer systems of Colon and Panama were made over, or rather created anew; the sanitation work throughout the Canal Zone called for piping of all kinds; the preliminaries for the housing and feeding of laborers included the construction of quarters, storehouses, ice plants, laundries, hospitals, etc., all of them fitted with modern plumbing and lighting plants.

The question of standardizing construction materials was an important one as affecting pipe, just as it affected all other equipment. The Isthmian Canal Commission found that rapid and thorough preliminary and construction work required both standardization and a formula that would insure the best of materials. A board was appointed to consider this matter, and tests were applied which were calculated to bring out the best points in American methods of manufacture. The Youngstown Sheet and Tube Company of Youngstown, Ohio, submitted a formula and specification for iron pipe and tubes which were finally adopted by the commission as a standard, and all material of that nature subsequently used at Panama either in preliminary work or in canal construction conformed to this standard.

The Youngstown Company received awards for over $400,000 worth of black and galvanized wrought steel and iron pipe, constituting shipments embracing practically every size and character. These shipments were made from the factory, after inspection by an engineer appointed by the Isthmian Canal Commission. As the operations on the Isthmus depended upon the promptness with which material was forwarded from the United States, it fell upon the Youngstown Company to expedite its shipments of pipe, and the manner in which this duty was performed drew forth praise from the government officials at Panama. The co-operation of American manufacturers was, in fact, a vital factor in the prompt and orderly evolution of the work at Panama. The history of the construction of the canal is also a history of American manufacturing efficiency—of good material honestly put together and systematically forwarded. The list of important manufacturers who contributed to the construction of the Panama Canal has become a roll of honor, and among the first to give cordial recognition to the efforts of American manufacturers were the engineers in the Canal Zone.

Cement and Concrete

Soon after the construction of the Panama Canal was commenced the Isthmian Canal Commission bought from the Allis-

Chalmers Company the first stone crushing plant used in the production of crushed stone for concrete work. This plant consisted of one No. 8 Style "K" and two No. 5 Style "K" Allis-Chalmers "Gates" Crushers, and the necessary auxiliary equipment. The plant was designed by the Allis-Chalmers Company and erected by the Isthmian Canal Commission near Ancon. Its capacity was about 1,000 cubic yards per day of eight hours.

Later on as the work progressed and the Gatun Locks were being constructed the government engineers decided to erect a plant at Porto Bello to produce the crushed stone required for this work. The rock in the Porto Bello quarry was very hard and abrasive, closely resembling that found in the Palisades on the Hudson River, New York. The operations at the quarry being of necessity very large, and the additional fact that the peculiar formation of the rock caused it to blast out in pieces of immense size, made the installation of a large preliminary crusher necessary to obtain maximum operating economies. The engineers of the Isthmian Canal Commission decided upon a No. 21 Allis-Chalmers "Gates" Gyratory Crusher for this work as the most modern machine.

The great and rapid advance made in crushing machinery is shown by the size of the receiving openings of the No. 8 crusher installed at Ancon as compared with the No. 21 installed at Porto Bello. The No. 8 crusher has two receiving openings eighteen inches by sixty-eight inches, whereas the No. 21 has two receiving openings forty-two inches by 114 inches, the former machine weighing approximately fifty tons and the latter about 235 tons. To give some idea of its immense size it should be noted that it will take pieces weighing four to five tons, breaking them down to about seven inches in one operation. This large crusher is capable of easily crushing 5,000 cubic yards of rock in eight hours, although it was never extended to its fullest capacity as only 3,500 cubic yards were used at the Gatun lock daily. The enormous size and weights of the individual pieces that go to make up this machine made the transportation and installation (the plant being located several hundred feet above water level) a difficult one, and much credit is due the management and engineers of the Isthmian Canal Commission in successfully mastering these problems.

The rock in the quarry was loaded with large steam shovels into six to eight-ton side dump cars, and trains of ten cars were brought by locomotive to the crusher and discharged into the feed hopper. After being crushed in this preliminary breaker to about seven inches the material dropped into a sixty-inch Allis-Chalmers pan conveyor and elevated to additional crushers which further reduced it to about three and one-half inches. The material used in the concrete work at Gatun locks being "crusher run," no sizing screens were necessary at the crushing plant. Its location being on a hill-side, all the crushed material flowed by gravity to a final conveyor located at the foot of the hill which carried it to the storage bins. These bins were located on Porto Bello harbor, and the material was loaded directly from these bins into barges having a carrying capacity of about 700 cubic yards. The barges were towed to Gatun, a distance of about thirty-five miles, and there unloaded with clam shell buckets.

By the middle of 1909 work on the locks had reached the stage when concrete construction began in earnest, and immense quantities of material were accumulated at Gatun, Miraflores and Pedro Miguel. The extraordinary size of the culverts and other conduits connected with the locks make it necessary that specially designed forms should be employed for the deposit of concrete. Experience in the construction of such works as the New York subways had demonstrated the superiority of collapsible steel forms over the old wooden forms. Although the first cost was higher, the steel forms proved much more economical in large operations, because of



1. Main shaft for crushing plant at Porto Bello.
2. Stone breaker.
(Supplied by the Allis-Chalmers Company, Milwaukee, Wis.)





1. Twenty-two-foot horseshoe shaped Blaw Steel Form for culvert construction, Panama Canal.
2. Eighteen-foot round Blaw Steel Forms showing telescopic features used for culvert construction in the canal locks.
(The Blaw Steel Construction Company, Pittsburgh, Pa.)

the rapidity with which work could be done.

After considerable study of the problem, the commission adopted a design furnished by the Blaw Steel Construction Company, of Pittsburgh, as being best adapted to canal work. Contracts were awarded to this company, and the forms were shipped to the Isthmus in July, 1909, and July, 1910. The accompanying illustrations give a clear idea of the manner in which the forms were used for culvert construction in the locks. The forms were of great size, measuring in some cases twenty-two feet in diameter, and were the largest in existence at that time. In the tropical climate of Panama wood forms would have warped and caused no end of trouble by losing their shapes, but the steel forms retained their rigidity under all conditions, and, of course, were not affected by tropical heat.

Instead of setting up a temporary form which would have been knocked down again with each completed section of the work, as is necessary when wood forms are used, the steel forms were merely telescoped and moved forward to a new section. No repairs or renewals were required, there was no waste labor or material, and valuable time was saved on account of the ease with which forms were set up and removed, and also on account of the accurate adjustment.

Since these steel forms were employed at Panama they have become a factor in other important concrete construction projects, notably in the aqueduct conveying Catskill water to New York City, and in the New York subways.

The steel forms furnished for the culverts through Miraflores and Pedro Miguel locks by the Blaw Steel Construction Company were ten, eighteen, twenty and twenty-two feet in diameter.

The heavy loads of concrete which these forms had to carry and the requirement that one section be passed through the others in position made it necessary to use the most advanced ideas in the design of a collapsible telescopic form.

The full round forms were made in five-foot sections, each section being divided into quadrants. The quadrants were rigidly braced with angles, making it impossible to distort the forms when handling or loading with concrete. The joint lines of the quadrants were on the horizontal and vertical planes. The horizontal joints were reinforced with lap plates spanning the joint from one quadrant to the other. At the vertical joints, top and bottom, hinges were provided for holding the quadrants together.

The moving of the forms was accomplished by means of a special traveler which ran on a track attached to the bottom quadrants. This traveler was provided with vertical jacks and side collapsing arms which engaged the top quadrants. The jacks and arms after being fastened to the top quadrants were collapsed, drawing in the quadrants to a position of less cross-sectional area than when in full position, so they could be passed through the sections in place. The bottom quadrants were collapsed by a rope and block and raised by a chain hoist to a position which would allow them to be telescoped.

The horseshoe-shaped forms were of the three hinges type. The sections were five feet long and divided into four parts called side sheets and wing plates. The side sheets were hinged together at the top and to the lower ends of the side sheets were hinged the wing plates. The collapsing and moving of these forms was done on a traveler constructed to run on a track which was laid on the finished invert of the culvert. The traveler was provided with vertical jacks and side collapsing arms. The vertical jacks engaged the forms at the top hinge joint and the collapsing arms engaged to side sheets above the joint of the wing plates. After the traveler was made fast to the forms, the wing plates were raised and folded in next to the side sheets. The side sheets were then drawn away from the concrete by the collapsing arms and the entire form lowered by the vertical

jacks sufficient to pass through the forms in position.

The water passages under the floors of the locks were made with a full round form. At regular intervals an opening occurs from these water passages up into the locks. This opening was formed by a special collapsible steel form which fitted on the full round form and projected up to the floor line of the lock.

These forms were built by the Blaw Steel Construction Company from their own designs, which were approved by the United States engineers. The forms were erected in the shops and inspected before shipment. No skilled labor was required to handle them, as all parts were interchangeable, thus avoiding any cutting or fitting after the forms were erected.

The Alpha Portland Cement Company, which from time to time furnished the Isthmian Canal Commission with large quantities of cement, is one of the largest Portland cement concerns in the United States, as well as one of the pioneers in the American manufacture of Portland cement.

When the Alpha Company started operations in 1891, there was but little Portland cement used in this country. The first equipment of the company consisted merely of two forty-foot kilns, and the yearly production amounted to only 100,000 barrels—a quantity that the six great plants of the Alpha can now produce in four days.

The mills of the Alpha Company are located at Martin's Creek, Pa., Alpha, N. J., Manheim, W. Va., and Cementon, N. Y. There are six great plants on six trunk line railroads. The Catskill plant, with its private docks, is also directly on the Hudson River and ideally situated for shipments along the coast, the barge canal, and for export purposes.

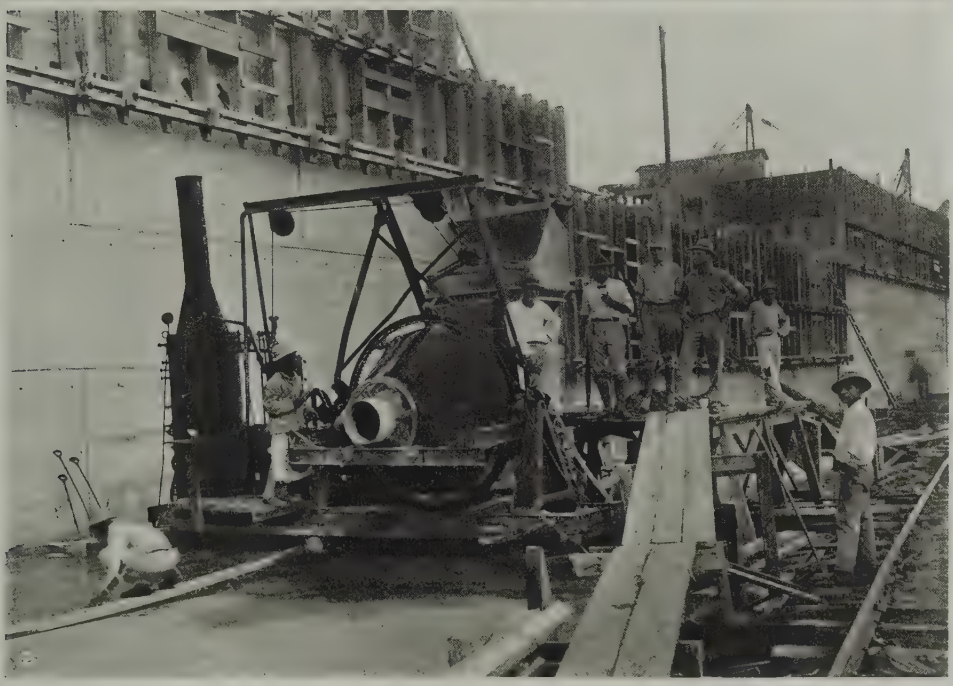
The product of the Hudson River Alpha plant has a characteristic that fortunately fits with its location, that is, the low percentage of alumina in the rock, which adapts the cement particularly to use in sea-water. Extensive investigations show that a cement of low alumina content gives the best results where concrete is exposed to salt water, sewerage acids, etc. For a time only imported cements were used in the under-water construction on the Key West extensions of the Florida East Coast Railroad. When Alpha cement was tested thoroughly it was found to meet every test, and thereafter was used in the under-water construction of the extension.

The Martin's Creek quarry of the Alpha Company is perhaps the best known of any of the Portland cement plants on the continent. Here are a thousand acres of the finest quality of cement rock, the face of the quarry being from 100 to 170 feet high, and the limestone possessing just the proper percentage of lime needed for a perfect Portland cement. In the blasting methods followed at the Martin's Creek quarry, holes are drilled in sets of ten to fourteen down the entire quarry face and snake holes driven in to meet the vertical borings. In the blasts as much as ten and one-half tons of dynamite are used to bring down the rock.

In addition to having been selected as one of the brands for use on the canal, Alpha Portland cement has been liberally used by the United States government in important operations, such as the fortifications at Egmont and Mullett's Keys, Forts Hancock, Wadsworth, Slocum, Monroe, Strong, Mott, Totten, and Schuyler, as well as in the Navy Yards at Portsmouth, Charleston, Brooklyn, Norfolk, League Island, and Boston. It has been also used extensively by the government for piers, sea walls, dry docks, light houses, etc. The company has recently enlarged its capacity so that now it has a producing capacity of 9,000,000 barrels a year, and storage facilities for 2,000,000 barrels.

One of the most remarkable records during canal construction was that of the Atlas Portland Cement Company. The government used 5,000,000 barrels of the company's cement in the Panama Canal without the rejection of a single barrel.





1. Austin concrete mixers at work on the canal. (Miraflores Locks.)
2. The mixers at work on the gate sills. Upper locks, Miraflores.
(Supplied by F. C. Austin, Municipal Building and Contracting Company, Chicago.)

Following this record the company then practically supplied all the cement needed to supply the canal work, following its first consignment of 5,000,000 barrels with additional shipments which soon ran over the half million barrel mark, and continuing until the canal was finished. In keeping with the policy of "safety first," cement was needed at Panama which by the most rigid and extensive tests could prove its superiority. These requirements were met by the Atlas Company, and the enormous consumption of cement for the work and the possibility of loss through idle equipment and a shifted payroll in case of slow deliveries made necessary the selection of a cement manufactured where production not only met but could exceed any demands made. The Atlas Portland Cement Company, having a daily productive capacity of 50,000 barrels, or 18,000,000 barrels per year, therefore was able to cope with any demands for Panama without interfering with other shipments. The company's productive capacity was and is by far the largest in the world. The first 5,000,000 barrels furnished by the Atlas Company was used in constructing the canal locks, and Gatun dam and spillway. Because of the importance of this phase of the construction the cement was given most rigid and exacting tests in the government's laboratories, and not a single barrel was rejected for any reason. This is an incomparable record of industrial efficiency in production and one which can scarcely be paralleled by any concern in the world. It can, therefore, be readily understood why the United States government when it found it would require a large additional supply of cement to complete the work decided to enter into a new contract with the Atlas Portland Cement Company to supply the cement required to complete the canal. If one could realize the magnitude of 5,000,000 barrels of cement or 5,000,000 packages of any kind, some appreciation could be reached of the feat of the Atlas Company in having this vast number of deliveries passed unchallenged by the guardians of the canal. The achievements in Panama will go down in history as monuments to those who labored there, but not the least among the achievements was the steady and uninterrupted delivery of great quantities of supplies of the highest efficiency by American industrial concerns.

Mixing the Concrete

A total, in round figures, of 5,000,000 cubic yards of concrete was required in the structures for the Panama Canal. The costs of this concrete are available only for main structures, but a fair average is perhaps $6 per cubic yard. In dollars and cents, therefore, the concrete work of the Panama Canal represents $30,000,000. Such an expenditure warranted extreme care in choosing all machinery for making concrete. Besides this reason there was the equally important reason that these concrete structures were for all time and were to be a monument, before the eyes of the world, of American engineering proficiency in concrete construction. Every motive of selfish interest as well as of professional honor and pride prompted exceptional precautions to insure concrete construction above criticism. One of these precautions, and logically the first that would occur to trained engineers, was superior mixing.

There were available to the canal engineers a number of different concrete mixers. Claims of superiority were made for all. No impartial comparative test records existed. In order to decide certainly which mixer was superior, it was determined to test in the field in preliminary work all those mixers which had gained prominence in engineering construction. The field tests were made, and from the experience thus obtained the decision was made to adopt the Austin improved cube mixer. Altogether over a hundred of these mixers were bought; they ranged in size from two cubic yards to one-third cubic yard; they mixed concrete for every canal structure from building blocks of less than

a cubic foot to the great Gatun Locks of 1,945,457 cubic yards in one mass.

The success of the Austin improved cube mixer in the preliminary competition at Panama was not fortuitous. This mixer had a history which was unique among the records of machines of its kind. The very first form of machine to be extensively used for mixing concrete was a cubical box, journaled at diagonally opposite corners, and having a door in one side through which the charge of cement, sand, stone and water was filled and the batch of mixed concrete was emptied. These machines were mechanically crude, but they produced a remarkably perfect concrete. Old concrete makers will recall the arrangement—a wooden box shod with iron and hung and bolted by the contractor's carpenter and blacksmith, but turning out a concrete so thoroughly and uniformly mixed that no hand-mixed product could compare with it. The cube mixer first demonstrated the great economy of machine mixing over hand mixing, and, it is essential to remember, it did so not because it presented any nicety of mechanical construction or because it gave an enormous output, but because it made a better concrete.

But to discharge the mixer the cube had to be stopped with the side containing the door on the bottom, and to charge it again it had to be turned until the side containing the door came on top.

In other words, some time was lost in unclamping the door to discharge the batch and in clamping it in place again to enclose the new charge. Altogether, the arrangement was unmechanical, but it had the saving grace of doing good work, even if it did it slowly. Through this quality it supplanted hand mixing. The army engineers, who until a few years ago were executing most of the concrete work being done, adopted the cube mixer. They did not require rapid mixing, but they did require unusually perfect mixing, and the old style cube gave them this. For twenty years no other mixer was used; practically no other mixer was known. Then the railways, the city engineers, the big public service corporations, and the general building public began to see the great advantage of concrete construction.

The possibilities of concrete reinforced with steel gave impetus to the movement. All this meant that more concrete had to be made, and made faster, and a multitude of inventors set about to devise a mixer that would beat the old style cube in rapidity of mixing.

Twenty years of experience had demonstrated that the perfect method of mixing concrete by machine was to hold the entire batch of materials together and incorporate them with one another by the criss-cross puddling action given by the revolving slides of a cubical box hung at diagonally opposite corners. The inventors who started out to improve the old style cube did not fail to perceive these facts. They adopted the batch principle at once, but the problem of retaining the criss-cross puddling action troubled them. They did not see how a cubical box could be mechanically arranged so that it would receive the charge and dump its batch quickly and without stopping. They took the easy road of substitution. Circular drums were substituted for the cubical mixing box, and as a smooth circular drum would simply slide from under the wet mass of concrete, sand, and stone, they riveted shelves or fins to the inside of the drums. To meet the criticism certain to occur that the crosswise movement of the materials, which was a cardinal feature of the cube, had been lost in their substitute, they fashioned their fins or shelves with a cant or slope, designed to toss the material back and forth longitudinally. Thus came about the rotating drum mixer with inside disintegrators. It was cheap and it turned out concrete rapidly, but the concrete was not cube-mixed quality.

The next substitution was the "continuous" mixer. In this machine the substitution of paddles was not only carried a step further, but a substitute for the





1. Gatun Spillway Dam.
2. Gatun Upper Locks.
(Cement furnished by Atlas Portland Cement Company, New York.)

batch principle was introduced. The reason was, again, cheapness and greater rapidity of output. Quality of mixture was still further discounted.

The remaining chapter in this story of substitution was the devising of the "gravity" mixer; a trough studded with pegs and ears was set on a stand and the cement, sand and stone chuted down it. Cheapness and capacity were advanced another step, and quality of mixture was practically relegated to the non-essentials.

Then there came a new man into the mixer manufacturing field, F. C. Austin, who took up the problem of bettering the old style cube mixer. His first step was to eliminate the idea of substitution and to set firmly in its place the idea of improvement. It was seen that there could be no substitute for the distinctively peculiar mixing action of the cubical box journaled at diagonally opposite corners, if concrete equal in quality to that produced by the old style cube was to be turned out. It was further accepted as an article of faith that quality of mixture must not be sacrificed to speed and cheapness of mixing. The task was to improve the old style cube mixer, to make of it a compact, portable, self-contained machine that could be charged and discharged without stopping and loss of mixer time. It would have been easier to design a substitute, but a careful study of the possibilities of substitution convinced this engineer that no departure from the cube principle could be made without deterioration in the quality of the product. This was a contingency which, as stated above, had been eliminated from the things to be even considered—the object was to improve the old style cube in every function it possessed, not merely to better its speed. The reader is not interested to know all the steps of this labor, but the result—the finished Austin Improved Cube Mixer—is the machine that mixed the concrete for the Panama Canal.

Briefly stated, the shaft which passed through diagonally opposite corners of the old style cube mixer was removed and replaced with hollow trunnions riding on rollers. These hollow trunnions were made large enough to serve as openings for charging and discharging the mixer. To rotate the cube, a strong circumferential rack was fastened around it on a drum at right angles to and midway between the trunnions. This rack, geared with a pinion shaft, was operated by the engine shaft in such a way that all gearing was removed as far as possible from the material which flies about in charging and discharging. To discharge the mixer, a simple automatic power dumping device was introduced, by means of which the discharge can be made by the man who operates the engine, an extra man not being required to tilt the dumping device. To permit the use of a larger cube in the same space, the sharp corners and edges were rounded. Finally the whole mechanism with its motive power was mounted compactly on a frame which could be put on wheels and moved from place to place.

The records of the Austin Improved Cube Mixer at Panama justify the selection by Mr. Austin of the cube mixer body and for all his labor in developing it into a perfect mixing mechanism. These Panama records are too voluminous to present, but a few selections indicate the character of all and demonstrate the claims made.

During the year ending June 30, 1912, Austin Improved Cube Mixers, ranging in size from one-half cubic yard to two cubic yards, mixed a total of 1,209,506 cubic yards of concrete. The actual working time of these mixers was 24,946 hours, or 3,118 eight-hour shifts. Therefore, each mixer mixed per hour worked, an average, for all sizes, of 48½ cubic yards, or one cubic yard every 75 seconds. This output record is the average of all mixers, large and small. Individual batteries of mixers made better records. For example: Two mixers working on Gatun Locks mixed 80,544 cubic yards in 1,175 hours worked, or 68.54 cubic yards per mixer per hour worked. Output life records have not been

computed, except in one case of a battery of two mixers which were withdrawn from canal construction and put on fortification work. These two mixers had, up to the time they were withdrawn from canal construction, mixed 410,000 cubic yards, or 205,000 cubic yards each. How much greater output life these two mixers have cannot be stated—they are still mixing concrete.

Represented in the American machinery used in concrete work at the canal were the concrete mixers furnished by the T. L. Smith Company, of Milwaukee, Wis., which furnished the canal commission with eight of its standard equipments between 1907 and 1909. All of the machines were portable outfits, of approximately half-yard capacity, and consisted of the mixer on truck, with engine and boiler, the entire apparatus in actual work discharging the mixed concrete into position without shoveling or wheeling.

The mixers furnished by the T. L. Smith Company gave thorough satisfaction at the canal. They had already won an enviable record in construction work in this country on the Florida East Coast Railway, the Galveston sea wall, the Roosevelt dam, and the great dams built at Keokuk and Helena, as well as in extensive concrete jobs completed by the government in Porto Rico, Hawaii, and the Philippines.

The Corrugated Bar Company, of Buffalo, N. Y., entered into canal work in October, 1908, and continued shipments up to June, 1912, its contracts in full calling for 2,150 tons of steel bars, used as reinforcement in concrete work at the Isthmus. These included operations in connection with the construction of retaining walls, locks, docks, and other similar building operations at the canal.

In addition to its headquarters at Buffalo, this company has district offices in St. Louis, New York City, Boston, Chicago, and St. Paul. It was the first to introduce the idea of a mechanical bond for reinforcement in concrete work, and it started in business in 1891 as one of the earliest of the expanded metal companies. Its engineers were responsible for the first scientific formula for the designing of reinforced concrete beams, so that it can rightly claim the place of being the pioneer in its particular line of activity in this country.

During the first ten years of its history, the Corrugated Bar Company confined its operations mainly to the line of fireproof construction, in which it acted as an engineering and contracting firm. Later it specialized in making designs and selling reinforcing material. During the entire period of its existence, it has never had a failure in its particular field of operation. This justifies to the fullest extent its slogan, adopted a few years ago, of "twenty-one years without a failure," for no building collapse ever followed where it furnished the design.

As regards the work of this company at the canal, its successes in competitive bidding were due solely to the superiority of its product. As steel and concrete have practically the same coefficient of expansion, tropical conditions on the Isthmus introduced no new difficulties that had specially to be met. But if they had, the corrugations on the steel bars furnished by the company made them independent of the question of adhesion. The corrugations on the bars are sufficient in number to make the bond positive and entirely independent of any adhesion with the concrete. These ribs are also designed in such a way as to entirely avoid, at all stresses short of the proof load, any splitting tendency on the concrete, this representing the patented novelty of this type of reinforcement.

Corrugated bars used at the canal were rolled from billet stock, and can readily be supplied either in medium or high carbon steel. Large stocks are carried at numerous points throughout the country for immediate shipment. More of this bar has been sold in recent years for concrete construction than of all other types combined, and it is generally regarded by engineers as

representing the last word in scientific design for concrete reinforcement.

Extensive examinations recently made of important concrete structures abroad, reinforced with plain bars, have indicated that the results were by no means as satisfactory as similar structures in the United States and elsewhere, reinforced with corrugated bars, and preparations are now under way in France and other foreign countries for the local manufacture of this material.

In the construction of the rock crushing plants for the concrete used in building the locks, a great quantity of accessory machinery was installed.

Hill friction clutches were specified and purchased in order to provide for the desired flexibility, as these clutches permit starting the motors under no load, and also provide for the instant release of the load in case of accident requiring repairs to any part of the equipment.

The Hill friction clutches have been manufactured since 1884. There have been many improvements made in the design and action since the original Hill clutch, but the essential principle of operation remains the same.

Both standard type and Smith type Hill friction clutches were installed,—the latter being a later development of the former, and perfected after the date of the first order.

English system rope drives were used for transmitting the power. The friction clutches were all used in connection with rope sheaves, and the complete drives were furnished by the Hill Clutch Company, of Cleveland, Ohio.

Another firm which furnished equipment designed for the speedy handling of large quantities of material was the Stephens-Adamson Manufacturing Company, of Aurora, Ill. It furnished the conveying machinery used in the crushing plant at Porto Bello, which supplied the stone for the concrete work in the canal. The equipment included two "S-A" pivoted bucket carriers and two "S-A" steel pan carriers, each with a capacity of conveying about 500 tons of material per hour. The company has installed many plants for handling crushed stone, with capacities running from 100 to 1,000 tons per hour.

Concrete dumping buckets constructed of steel and iron for handling concrete on the canal were supplied by the G. L. Stuebner Iron Works of Long Island City, N. Y. These buckets were supplied under five separate contracts entered into between the canal authorities and this company, running over a period of several years. The contracts were repeated as the buckets were needed. They were correctly balanced, thoroughly well constructed in every detail, and worked perfectly.

Hercules steel bumping posts, placed in cement foundations at the ends of the towing tracks for the use of the electric towing engines, were furnished to the canal by the Railway Traction and Supply Company of Chicago. These bumper posts were made of boiler plate steel, each weighing about 1,000 pounds.

They were adopted on the canal because they were stronger than any other post, more easily installed, and had greater strength and lasting qualities. They are impervious to tropical insects or climatic influences, with no wood to decay or burn, and take up comparatively little track room.

There were six heavy car springs in the head of each post, making the use of the bumper very easy on the equipment, the engines catching the bumper as though coupling to another car.

Equipment for the Lock and Dam Gates

As described elsewhere, the construction and general equipment of the gates for the Panama Canal locks developed problems in mechanical engineering, including operations in the foundry and machine shop, of such stupendous proportions as scarcely to be overshadowed by the civil engineering work on the Isthmus.

The material and construction work on the gates required for the flights of locks

of the canal system were largely furnished and performed by the Wheeling Mold and Foundry Company, of Wheeling, W. Va. The total contracts of this company amounted to 19,000 tons, comprised in iron and steel castings for the locks and gates (these furnished by the company), and in 334 machines for operating the gates and valves (furnished by direct contracts with the Isthmian Canal Commission); in conductor rails for supplying current to the electric locomotives that tow vessels through the canal locks on a cogged way; some 40,000 pounds of manganese bronze; rolled nickel-steel pins, bearing-plates, and the like; and a pumping system covering 350,000 pounds of piping, valves, etc.

In the general contract for all the gates proper, the Wheeling Mold and Foundry Company supplied not only the yoke and the pintle bearings, and the quoin end and miter and reaction castings, but also the nickel steel bearing plates for both ends of the gates. It also furnished the heel casting which carries the entire weight of the gates on the pintle bearing, this being the most important casting used in connection with the gates. It has been estimated that if all the gates leaves in the canal were to be piled on top of one another they would make a tower more than a mile and a quarter high.

The mechanism for operating the gates is one of the most interesting features of the mechanical engineering work at the Panama Canal. The motion imparted to the leaf is by means of a machine so constructed that it is capable of exerting its greatest force at the moment when the resistance is greatest, and it is to be emphasized that the rate of increase of the force from minimum to maximum is, in fact, greater than the rate of increase of the resistance. The contract for the ninety-two complete machines thus required was taken directly by the Wheeling Mold and Foundry Company.

In addition to furnishing material for the gates, the Wheeling Mold and Foundry Company also furnished for the McClintic-Marshall Construction Company the castings for the two gates for the Balboa dry docks, these being practically duplicates of the lock gates, and also furnished, through the commission, two moving machines to operate the gates.

With regard to the rising-stem valves and the machines for their operation, the valves themselves were obtained under a separate contract. However, the contract for the machines and the lifting connections of the mechanism was awarded to the Wheeling Mold and Foundry Company, for the entire 116 machines, which are for the valves that control the main culverts of the locks. The total weight of the moving parts is 22,500 pounds in air, while the rising-stem valve machines' complete weight is about 7,200 pounds. The guide frames for the machines had to be built into the solid masonry, and were therefore ordered considerably in advance of the machines proper. The material for the frames, also furnished by this company, amounted in weight to about 9,000,000 pounds.

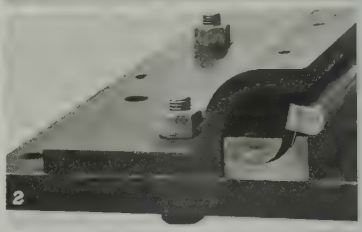
The cylindrical valves used for operating the gates for each lock chamber are located at the points where the lateral waterways for filling the locks connect with the main culvert. They are six and one-half feet in diameter, and have a lift of three and one-half feet. Each is connected to its driving mechanism by a machine built by the Wheeling Mold and Foundry Company, there being 130 of these machines in all, weighing altogether about 550,000 pounds.

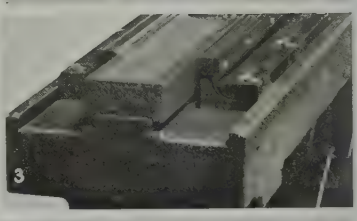
The foregoing account only briefly reviews the operations of this company in its relations with the construction work at the canal, but it is calculated to indicate its capabilities for handling unusual work as well as work of great magnitude. The work with the Isthmian Canal Commission represents four important contracts, all secured in open competition.

The personnel of the Wheeling Mold and Foundry Company is composed of C. E. Blue, president of the company since its



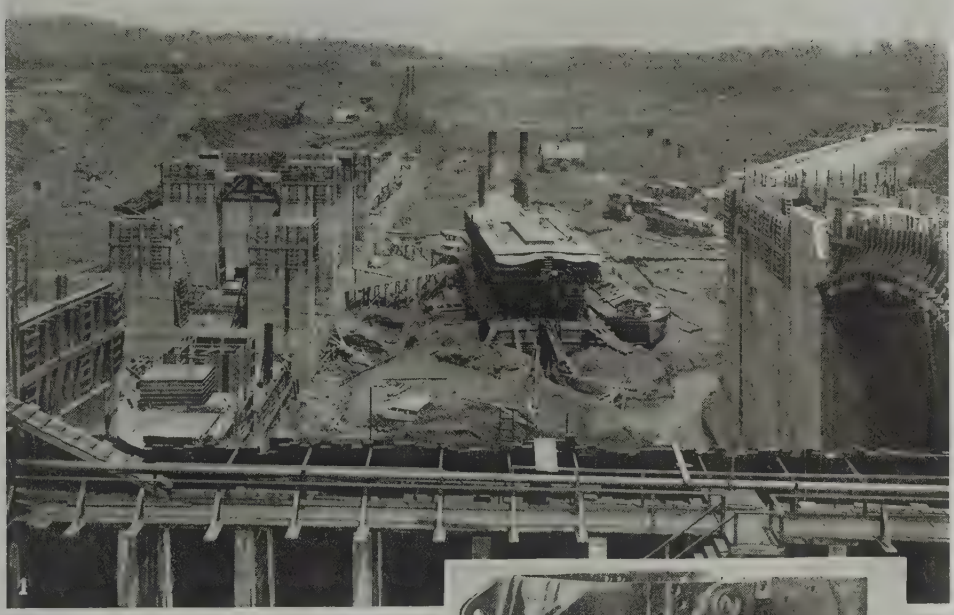


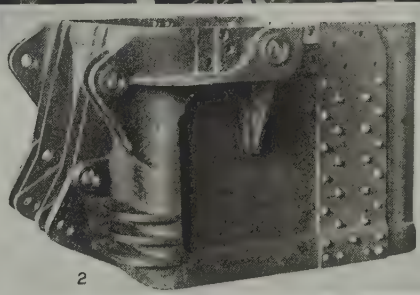






1. Roller trains for lock gates. 2. Sealing device for rising stem gate valves. 3. Assembling the sealing device.
4. Bathing the rollers in oil. 5. Forging the rollers.
(Lock and Dam Mechanisms made by the Westinghouse Machine Company, East Pittsburgh, Pa.)







1. Method of using steel bars furnished by the Corrugated Bar Company, Buffalo, N. Y., for reinforcing concrete and other construction.
2. Dredge dipper made entirely of manganese steel furnished by the Edgar Allen American Manganese Steel Company, Chicago, Ill.
3. Loading Western Wheeled Scraper Company's (Aurora, Ill.) dump cars in Culebra Cut.

organization, in 1897; L. V. Blue, vice-president; F. du Pont Thompson, chief engineer; H. S. Bradley, secretary; H. Quarrier, treasurer; W. V. Hoge, Jr., business manager, and E. C. Rauschenberg, superintendent.

The Steacy-Schmidt Manufacturing Company of York, Pa., furnished all the machinery to operate the spillway gates at Gatun and Miraflores lake, with the exception of the electric motors. These spillway gate machines are designed to raise or lower the spillway gates for controlling the water levels of Gatun and Miraflores lakes. There are twenty-two gates, fourteen at Gatun and eight at Miraflores. Each machine consists essentially of two counterweights of approximately 47,000 pounds each, one at each end of the gate.

The screws are of a special composition forged bronze, 4⅛ inches diameter and practically 28 feet long over all with 24 feet of thread, of 1 inch pitch. The chains are made of 2-inch diameter stock of a total length of approximately 67 feet each. Each link is 5 inches wide and 7⅛ inches long. There are 44 screws and 44 chains for the 22 machines.

The counterweights practically balance the weight of the gate, so that the machines have to overcome only the resistance to the movement of the gates due to water pressure. The counterweights are guided and travel in pits beneath the floor of the machinery tunnel.

The machinery tunnel extends the full length of the spillway within the dam and contains all the operating machinery. The screws for lifting the gates pass through this tunnel, extending downward to the counterweights and upward to the hoisting chains through openings provided for the purpose.

The machinery located in the tunnel consists of the worm nuts, worm wheel castings, motor, motor driving shafts and limit switches. Portable hand operating devices are provided in case the electric motors are disabled or out of commission, which are clamped to the driving shafts when in use and are operated by two cranks.

The two-inch hoisting chains are connected to the upper ends of the lifting screws, passing up through pipes at the top of the gate piers, run over sheaves and down to the gates, where they are fastened approximately in the plane of the center of gravity of the gates.

The sheaves on the bracket move with the gate until the gate is above water, where the movable sheaves are engaged by a casting projecting from the pier, thus causing the roller train to rise more rapidly. When the gates reach the end of lift the roller train is well clear of the water, thus protecting it from floating débris. Just before the roller train starts to move more rapidly than normal the gate is moved bodily up stream a short distance by two rollers near the ends, so that the pressure is removed from the roller trains, enabling them to move freely.

The limit switch geared to the driving shaft prevents over-travel at the two ends of travel of the screw by cutting off current from the motor in the direction of travel. The limit switch allows the motor to be reversed at the ends of travel or at any intermediate point.

The main level of the canal being much higher than the sea level, the vessels using the canal are raised by water collected in the upper lake, mainly during the rainy season. Should the locks become damaged through any means and this water escape, the entire canal would be rendered useless until the next rainy season. This contingency was foreseen by the Canal Commission engineers, who carefully worked out a system of emergency dams in the form of pivotal bridges carrying hinged girders and sliding water gates, together with the machinery for their operation. These emergency dams are pivoted at one side of the canal and will normally lie parallel with the waterway, but are so arranged that in the event of a breakage to a lock gate permitting the escape of water, they

may be quickly swung across the waterway and the emergency gates dropped to prevent the further escape of the water. In the event of damage to a lock by a vessel which afterward should founder between the gates, the emergency dams will be of value in permitting the prompt raising of the ship and its removal from the path of traffic. The wicket girder and gate-hoisting machines for the emergency dams at the Gatun, Pedro Miguel, and Miraflores locks were supplied and installed by the Otis Elevator Company, of New York City.

The Westinghouse Machine Company, whose offices and works are at East Pittsburgh, Pa., furnished the sealing devices to render watertight the rising stem gate valves and the spillway gates. They also furnished the roller trains upon which the valves or gates move in their comparatively frictionless passage.

Most of this machinery thus provided is under water, and being out of sight and difficult of access for repairs, the materials employed are the very best for the purpose, and the workmanship and execution are of the highest order.

The rising stem gate valves, and the spillway gates travel on roller trains. There are sixty-three rollers in each train for the rising stem valves, and forty-seven such rollers in each of the trains for the spillway gates. The rollers themselves are made of open hearth steel of a grade known as "tool steel," which is especially low in sulphur and phosphorus and contains about 0.70 per cent. carbon.

In the execution of this contract 18,794 rollers were required. These rollers are four inches in diameter and six inches in length of working face, and have a trunnion on each end, which trunnions engage in suitable holes, in channel bars, thus maintaining constant and perfect alignment.

The rollers were first cast in ingot form and rolled down in blooming mill to four and one-half-inch square billets. They were then reheated and hammered in swage dies to four and one-half inches round, after which they were cut into suitable lengths and turned to size slightly larger than the finished dimensions. The rollers were then heat treated and oil tempered to improve their wearing qualities and to harden the working faces, after which they were ground on centers to precise size.

The channel bars which keep the roller train in alignment are rolled steel sections especially made for the Canal Commission, planed on the inner faces and drilled to hardened steel templates so as to be perfectly interchangeable, and fitted together with steel distance pieces and steel bolts, the latter being protected by a process of zinc coating known as sherardizing.

The rollers were forged into round bars in the forge department of the Westinghouse Machine Company. After forging, the round bars were carefully annealed in a special annealing furnace, in order to make it possible to machine these high carbon rollers at the desired speed. After annealing, they were cut into appropriate lengths, turned to proper size, with allowance for subsequent grinding, and were hardened by being heated to proper temperature by electric pyrometer, and quenched in oil. In the heating descent from the cold region to the hottest part of the furnace, gradual and even heating was insured.

In order to protect the trunnions, or small projecting ends, from being over hardened, special tongs were employed to pick the rollers out of the fire. These tongs prevented the cooling oil from coming in contact with the trunnions until the body of the roller had been partially cooled by immersion in the oil. The operator seized the heated roller with the protecting tongs, dipped the roller in the oil bath, and moved the heated roller back and forth through the oil for a stipulated number of seconds; this time being determined by careful experiment. At the expiration of this perfectly definite period, he removed the tongs and allowed the partially cooled roller to drop to the bottom of the tank of oil.

The oil was kept at a constant temperature by means of water cooling pipes placed in the tank, and kept violently agitated by submerged compressed air pipes, which kept the oil thoroughly stirred and in constant circulation.

The hardened rollers were carefully tested in the shops to insure against overhardening or brittleness. In order to obtain a standard blow employed in testing a roller to destruction, it is first clamped rigidly at the foot of a drop hammer, and the trunnion has a ring slipped over it, so as to cause the blow to strike constantly at a fixed distance from the body of the roller. The weight is lifted to a fixed height and automatically tripped at the top. The total number of blows which a roller will stand in such a test is a fairly accurate measure of its resistance to breakage.

The rising stem gate valves are made in the form of hollow box-like structures built up of structural steel shapes and steel plates.

These box-like structures must slide up and down in metal-lined ways with sufficient freedom to prevent danger of sticking, and this freedom of fit would result in water leakage if it were not for the sealing devices which are employed.

The valves have in the neighborhood of 1¼-inch latitude in this sliding fit, and the sealing devices are elastic, spring mounted strips calculated to yield under the pressure of the water, and make contact between the valves proper and the metal lining of the ways.

The material of the sealing device is manganese bronze of very high tensile strength. The elastic spring portion of the device is of the same material. These manganese bronze shapes were produced by the extrusion process, and the bars of which it is composed were extruded or hydraulically forced through forming dies in such a way as to impart great density and strength to the bronze bars as well as insuring other high physical properties.

Bronze was used because the device will be wholly under water, and because any material which would rust or corrode would be prohibitive on account of the inaccessibility for repairs. The sealing devices are made right and left hand for each gate. The central bar of the assembly table is made movable, and can be thrust to the extreme right or to the extreme left position corresponding with the possible erratic movement of the gate in opening and closing. These strips were tested so as to prove water tight in the shop.

The sealing devices, being somewhat delicate, might be easily damaged by floating débris. They are protected by closely fitted steel castings, called protection castings, which prevent anything coming in contact with the sealing device that might damage them.

The spillway gates are some forty-eight feet in length, and since they were certain to deflect under pressure of water, special rocker bearings were devised to take care of this deflection and insure at all times a normal bearing on the roller trains, and the easy opening and closing of the gates.

These roller train tracks and rocker bearings were produced from rolled open hearth steel of a tensile strength of about 100,000 pounds, and the semi-circular grooves were milled with great exactness so as to perform the function perfectly.

All of the machine work on these parts was done through jigs, so that every part was interchangeable with every other like part, and the material was inspected in each stage of manufacture by government inspectors.

The great castings which were used as slides or seals, and gate guides for the gates on the canal were furnished by the Excelsior Tool and Machine Company, of East St. Louis, Ill., a firm which had made a record with all government officials for prompt deliveries. In the case of the castings, it received the order direct from the commission. These castings filled twenty-four freight cars, and weighed a total of 1,200,000 pounds. The castings were machined and bolted together in

three sections, making the total weight of each section 10,000 pounds. Twenty-eight sections were required for the fourteen gates for the Gatun spillway, and sixteen sections for the eight gates for the Miraflores spillway.

The canal officials were especially interested in spillway construction, and the working of the equipment supplied by the company was completely satisfactory, both from the standpoint of prompt delivery and operation.

The valves used to control the inlet and outlet of water in the locks at Gatun, Miraflores, and Pedro Miguel were furnished by the Rosedale Foundry and Machine Company, of Pittsburgh, Pa., at a total cost of approximately $210,000, all the material being required to pass rigid inspection. In all, 121 valves were furnished by this company between the middle of December, 1909, and the latter part of May, 1911, when the last consignment went forward to Colon.

No unusual preparations followed the award, as the rolling mills and forging shops of Pittsburgh, as well as the foundries and machine shops of the company, were equal to the situation, and only standard equipment was called into service. Although the general principles of construction involved in the valves were not new, special original features had been introduced by the government designers and had to be met, on account of the heavy duty which the valves were required to perform, and the effect upon the materials of the tropical climate. The steel material subject to deterioration was all galvanized and sherardized, the latter being a special process to protect steel from the attack of rust.

The boiler and superheated pop safety valves and gauges for the Gatun dam power-plant were supplied under a subcontract by the American Steam Gauge and Valve Manufacturing Company, of Boston, Mass. The company under its own contract also supplied the commission with numerous valves and gauges. This company was organized in 1851, first manufacturing Bourdon steam gauges in the United States. In 1884 the business was extended to the manufacturing of boiler pop safety valves and kindred instruments. The pop safety valves manufactured for the canal work were first tested at the naval academy at Annapolis, and stood the severe test to the satisfaction of the commission.

The operating mechanisms for the collapsible hand rails and the guard valves on the locks were furnished the government by the Earle Gear & Machine Company, of Philadelphia, Pa., a very large concern, which in its manufacturing division devotes particular attention to cut gears and special machinery.

Gauges for registering the depth of the water in the locks of the canal are an important feature of the lock mechanism, and it was necessary to secure gauges constructed of material that would be as lasting as the locks themselves. The final decision was in favor of the gauges manufactured by the Mosaic Tile Company, of Zanesville, Ohio. The gauges are now in use in the Gatun, Pedro Miguel, and Miraflores locks, and no doubt is entertained as to their wearing qualities.

This company supplied the vitrified floor and glazed tiling used in the Gatun hydroelectric station; the Gatun, Miraflores, and Pedro Miguel control house, and the tiling for the baths and lavatories of the Tivoli hotel.

It also furnished the tiling used in the floors and walls of the new administration building, this selection demonstrating that its worth had been established in the eyes of the canal officials.

One of the difficult problems confronting the builders of the canal was to devise a method for the preservation of the vast amount of costly steel work connected with the construction. Climatic conditions on the Isthmus are such as to make all steel subject to corrosion, thereby greatly shortening the life of the steel. When it is remembered that hundreds of tons of steel





1. Laying Alpha Cement at Miraflores Spillway Dam.
2. Part of a single order of 20,000 barrels of Alpha Portland Cement.
(Cement from the Alpha Portland Cement Company, Easton, Pa.)

of a high grade were necessary for the work, and that the safety of vessels and cargoes might be greatly endangered should any part of the steel used give way on account of the corrosive action of the water or climate, the importance of finding the best protector for all the steel work will be readily seen.

The forty-six lock gates present an internal surface of more than 3,200,000 square feet, all strongly subjected to the deleterious influence of the climate and water. The same is true of the dock gates at Balboa, the automatic gas buoys, and anchorage boxes. To replace one of the lock gates would require a large expenditure of money, and cause a loss of much time, and might materially interfere with canal navigation for many days. Under all these considerations it became necessary to secure the best preservative from corrosion that could be had.

The lower half of each gate is an air chamber, into which water will rarely enter, while the upper half is a water chamber, which is filled and emptied many times each during the progress of locking, thus offering the most destructive corrosive conditions which could possibly obtain. As the most effective and permanent protection against these corrosive conditions the canal engineers, after an exhaustive investigation, adopted "Bitumastic" solution and enamel, made by The American Bitumastic Enamels Company, of Philadelphia, Pa.

In the words of one of the leading engineers connected with the construction of the canal, the main reason for the selection of this special material was its excellent record in the vessels of the United States navy and on foreign vessels of war, as well as vessels engaged in the merchant marine. So successful has been this material in meeting the requirements of the difficult conditions on navy vessels, and other ships, and so great was the faith of the canal engineers in its efficiency, that after the work of construction was started they specified "Bitumastic" on five other contracts connected with the construction of the canal.

The company began preparations to fill its first contract August 12, 1911, and since that time the "Bitumastic" was used on forty-six lock gates, the Balboa dock gates, fifty-seven automatic gas buoys, ninety-two anchorage boxes, and on material used in the hydroelectric plant.

Thus American manufacturing ingenuity and excellence of materials contributed to the successful construction of the great steel structures at Panama, and insured their permanence under the most adverse conditions. The same care displayed in construction is exercised in the upkeep of the costly canal equipment, and American manufacturers are always ready to meet any demands.

Steel and Iron Castings, Machinery, and General Tools

Everything about the canal work spelled immensity. Machinery and supplies did not reach the Isthmus in small units. If rubber hose was wanted, the material totaled miles in length. If metallic equipment or fittings were needed, the amount ran into millions of pounds. As the work progressed, the Isthmus accumulated the greatest collection of machinery, tools, steel and iron material, mechanical parts, and equipment which the world has ever seen assembled in one territory. A great number of American firms participated in supplying this varied and vast quantity of material.

A large part of the manganese steel castings for use on the canal work was furnished under contract by the Edgar Allen American Manganese Steel Company, of Chicago, Ill., and New Castle, Del. The steel used in these castings was entirely of the "Stag" brand manganese steel. The castings furnished by this company were for use as repair parts for steam shovels, such as dipper teeth with renewable points, dipper lips, latches, latch keepers, dipper-shaft pinions, racks, dredge tumblers, link pins, bushings, screen sections and car wheels. This company also furnished three

complete dippers made entirely of the "Stag" brand of manganese steel. One contract alone called for more than sixty-four tons of tooth points. The first contract with this company was in 1908 and others rapidly followed. "Stag" brand manganese steel was found particularly adaptable to wearing parts of the excavating machinery, owing to its extreme toughness. Manganese steel is so tough that it cannot be machined except by grinding, yet it can be bent cold without breaking.

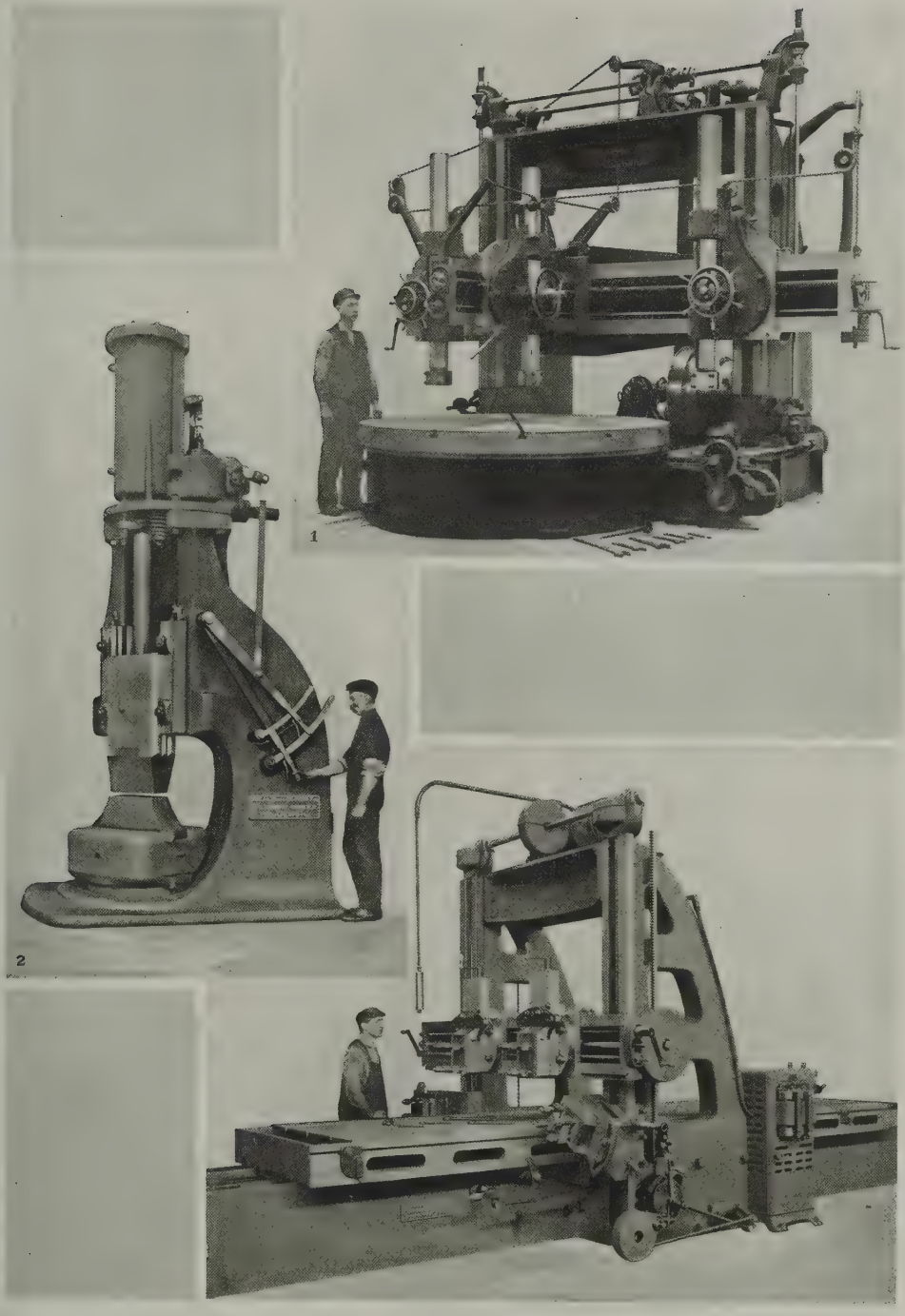
One of the government requirements in connection with material ordered is as follows: "Test specimens one-half inch by three-fourths inch cast under the same conditions and given exactly the same heat treatment, shall bend cold around a diameter of one inch to an angle of 180 degrees without cracking or exhibiting other signs of failure."

Another large firm which supplied steel castings for the canal work was the Detroit Steel Casting Company, of Detroit, Mich., which furnished large quantities of miscellaneous steel castings for dredges, machines, railroad equipment, and dump cars. In all it entered upon more than twenty-five contracts, running from 1909 to the completion of the work. This large number of contracts required no special preparation on the part of the company, as its plant was equipped to handle the orders easily with its standard equipment. All these contracts were secured in competition with other manufacturers. Its castings were turned out by the open hearth method.

The firm of Frank Samuel, of Philadelphia, Pa., consisting of Frank Samuel, S. M. Tomlinson, and S. A. Cochran, supplied a large tonnage of pig iron and alloys to the Canal Commission. Their facilities for international business fully equipped them for this feature of construction supplies, the materials furnished by them going to the foundry at the Isthmus, where it was converted into the castings used in connection with the construction of the canal. This firm also made extensive purchases from the Canal Commission, large quantities of equipment, such as locomotives, engines, pumps, and other similar supplies no longer needed on the work having passed into their hands.

Among the contractors furnishing mechanical supplies, the H. A. Rogers Company, of New York City, was prominent from the very inception of the work. When the French company was attempting to construct the canal this company furnished large quantities of gauge glasses, pulleys, steam gauges, waste, shovels, picks, etc., and when the American government took hold of the enterprise it became an active and most successful bidder for the same line of supplies. During the course of construction it sold to the commission many thousands of dollars worth of materials, consisting mainly of gauge glasses, pulleys, steam gauges, cement, gauge glass washers, gaskets, pliers, cotters and planer knives. The Rogers Company, having been the sole United States agents for the Moncrieff gauge glasses—the glasses used altogether by the canal officials—has sold to the commission all such glasses used on the canal. The tremendous energy by which the work was pushed to completion made necessary large supplies of tools, and various parts of machinery, and when it is remembered that nearly everything bought in connection with the construction work was by the competitive bidding on specifications most carefully and rigorously prepared, it will be recognized that only the best was offered to and accepted by the commission. This rigorous supervision extended to the smallest tools purchased, and to be a successful bidder was to receive a certificate of quality of goods handled.

Early in the history of the construction of the canal the purchasing agents were solicitously engaged in search for a chain that could be used with their steam shovels for the longest continuous period without breaking. This was particularly desirable, for with a break in the chain the shovel stops, and all the work must stop with it, with consequent loss of time as well as expense for repairs.



1. Niles boring and turning mill.
2. Bement hammer.
3. Pond planer.

(High class canal machine shop equipment furnished by the Niles-Bement-Pond Company, New York.)

After trials with various kinds of chains, that manufactured by the Columbus Chain Company, of Columbus, Ohio, was finally selected. It gave such satisfaction that the "Hercules Solid Weld" steam shovel chain manufactured by that company eventually became a standard in canal construction work. This chain is made of the highest grade of material, by a special formula, and has assisted in no small degree in bringing to pass the unequaled records achieved by the modern empire builder, the American steam shovel. Its record at the canal in the heaviest sort of service—that carried on in the stone quarries—has shown a continuous service for as long as eleven months without a single broken link.

From the beginning of construction work on the canal, the Buda Company, of Chicago, Ill., made extensive shipments under their contracts covering articles used in railroad building. All supplies furnished by them were of their own manufacture, and their plant was fully equipped and ready to furnish a class of material that is recognized as standard on ninety per cent. of the railroad mileage of the United States. Among the articles furnished, all bearing the firm's name, were hand cars, push cars, pressed steel wheels, track jacks, track bits, drills, switch stands, replacers, rail benders, gauges, levels, and automobile engines. More than a thousand cars and over three thousand switch stands went toward filling contracts that reached a total of $125,000 with this firm.

In the construction of the canal the successful completion of the work depended, to a great extent, on the continuous working of the construction machinery, such as steam engines, cars, steam shovels, concrete mixers, conveyors, etc. The heavy and continuous service required of the canal equipment caused break-downs of mechanical parts, thus causing delays and expense, and interfering with the continuance of the work. To avoid these delays the commission installed a large machine shop near the base of the work, where duplicate parts could be made or repairs quickly accomplished.

The machine shop covered a wide range of work. It was largely equipped by the Niles-Bement-Pond Company, of New York City. This company occupies a foremost place among machine tool manufacturers and crane builders. The largest and heaviest machines were required for repairing steam engine parts. The Niles-Bement-Pond Company furnished for this work several machines designed especially for such service. The heavy engine drivers were turned on the Niles driving wheel lathes; car wheels up to forty-two inches were turned on Pond car wheel lathes; Bement axle lathes turned and trued the axles; the wheels were pressed on the axle by Niles hydrostatic wheel presses of 200 and 300 ton capacity.

Boring, drilling, turning, and planing machines were furnished for the ordinary machine shop operations. To handle large and heavy repair parts and castings through the shop, the Niles-Bement-Pond Company installed several electric traveling cranes. These cranes would pick up, carry, and set down pieces weighing from one ton to sixty tons, with the precision of the human hand.

In equipping the machine shop, the American Tool Works Company, of Cincinnati, Ohio, was the successful bidder on a number of occasions, and consequently the company was well represented in the Canal Zone.

The American Tool Works Company is one of the largest and oldest builders of lathes, planers, shapers, and radial drills in this country, employing 600 men in their works in the exclusive production of the above-mentioned machines. The types of lathe built by the American Tool Works Company for use in the Canal Zone were built in various sizes from fourteen inches to forty-two inches swing. One of the principal characteristics of the "American" lathe is its patented drop bed, which gives additional swing over the nominal swing, and also permits the use of an unusually

deep carriage bridge. A complete quick change gear mechanism is supplied on all sizes of American lathes. It is of the cone and tumbler type, affording forty-eight changes for screw setting and feeding. In addition to this standard range any odd thread can be secured by simply adding a special gear to a quadrant provided for this purpose.

The multifarious details of the work of constructing the canal will probably never be understood and appreciated. For illustration, one firm, the Oliver Iron & Steel Company, of Pittsburgh, Pa., supplied to the commission about 13,000,000 pounds of such small articles of iron and steel as bolts, rivets, nuts, washers, picks, mattocks and claw bars. These articles were used in every branch of the construction work, and were supplied by the Oliver Company on contracts with the Canal Commission.

During the months of May, June, August, October, November, and December, 1912, the Pittsburgh Steel Company, of Pittsburgh, Pa., shipped to the Isthmus of Panama 349 tons of wire nails, and in May also ten tons, or fifty-five miles, of steel wire. All of this material was used in the construction work of the canal.

Basic open hearth material is used exclusively in all the steel and wire products manufactured by the Pittsburgh Steel Company, hence it was this superior material which went into the products supplied to the Canal Commission. Open hearth steel wire possesses a fine, even texture of strength and durability, and because its characteristics exist uniformly throughout the wire, from its skin to its core, it delivers the same high quality of service under all conditions of climate.

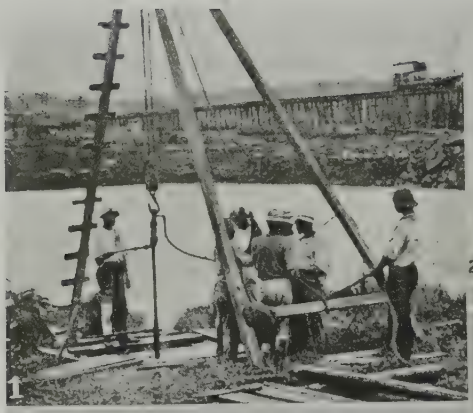
This company owns and operates the largest independent plants in the world manufacturing fencing, nails, and wire. The site embraces 160 acres of land along the Monongahela river front, with forty-nine and one-half acres under roof, and a water frontage of two and three-tenths miles. The company owns 60,000,000 tons of iron ore in mine, which it ships down as needed, unloads by its ore car dumper at the rate of thirty cars an hour, and stores by two massive traveling bridges. Its two blast furnaces, with a capacity of 1,400 tons daily, are the only electrically operated furnaces at the present time.

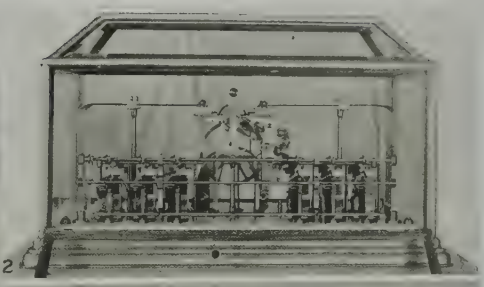
The finishing departments include two complete modern rod mills, one barbed wire mill, three galvanizing plants, and a factory for making electrically welded wire fencing. These departments are all at Monessen, Pa., but at Glassport, a few miles down the Monongahela River, the Pittsburgh Steel Company maintains complete mills for hot rolling all sizes of steel hoops used by the cooperage trade, steel bands, cotton ties, bars for concrete reinforcing, and rim stock for automobiles and motorcycles.

The annual capacity of the plants is 500,000 gross tons a year. Among other wire products from the finishing mills is a daily output of 350 miles of electrically welded wire fencing, 200 tons of barbed wire, and 8,000 kegs of wire nails.

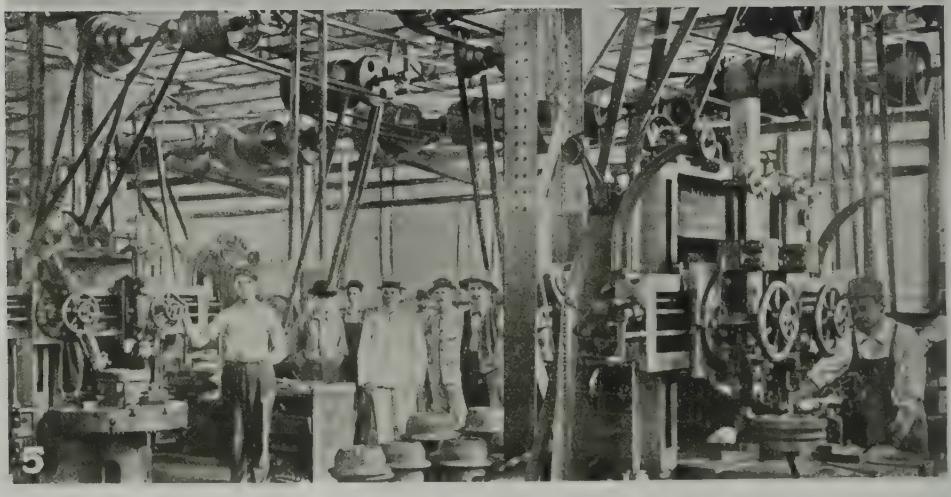
Chain iron, special bar iron, iron roofing sheets, Carter special and Carter stay bolt iron were supplied the canal workers by the Carter Iron Company, of Pittsburgh, Pa., one of the largest concerns in this line. The company has furnaces at Ivanhoe, Va., and rolling mills at Paden City, West Virginia.

A firm located at the seat of government in Washington, and which furnished a great variety of iron and steel appliances for the canal, was the J. B. Kendall Company. This firm supplied thousands of tons of steel bars for concrete reinforcement, several thousand tons of steel bars, plates, channels and beams, railroad spikes, wire nails, and rivets, mostly manufactured by the Jones and Laughlin Steel Company, of Pittsburgh, Pa. The Kendall Company also furnished a large number of twist drills for use in canal construction, the drills being those manufactured by the Cleveland Twist Drill Company, of Cleveland, O.

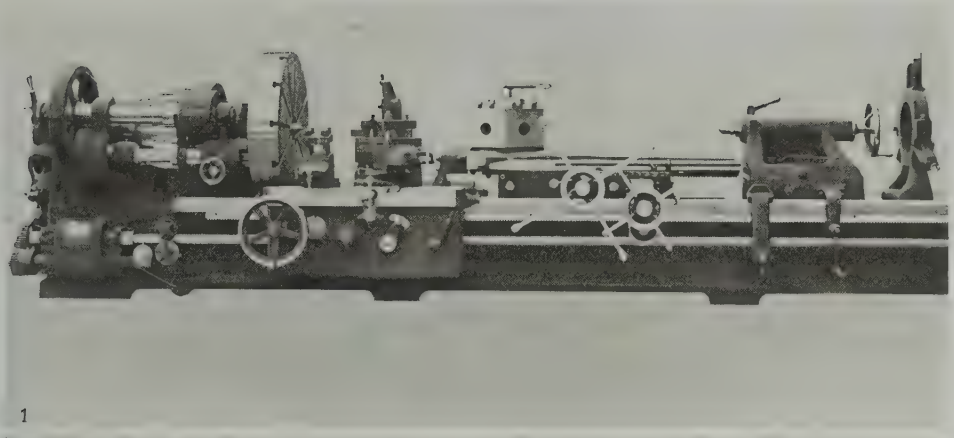




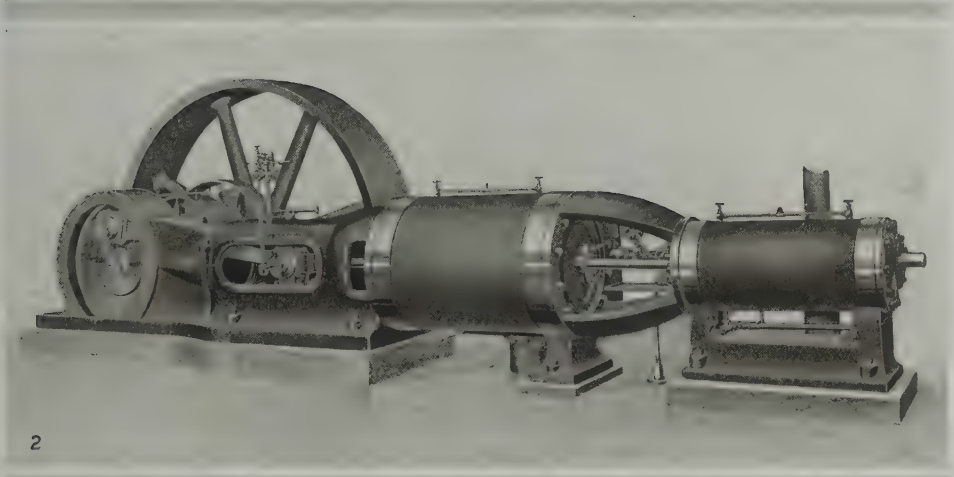




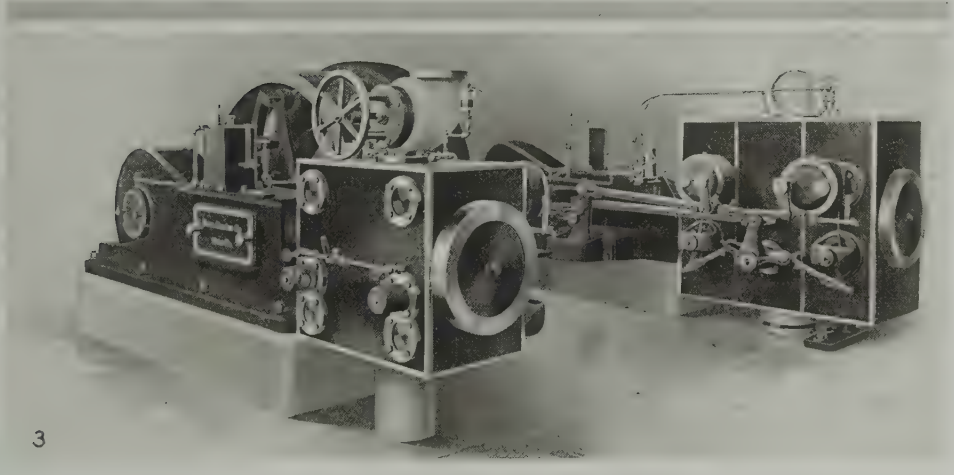
1. Artificial limb furnished by A. A. Marks, New York, to a canal workman.
2. Automatic repeater. (Gamewell Fire Alarm Telegraph Co., New York.)
3. Standard fire alarm box, Gamewell system, used in Canal Zone.
4. Duxbak waterproof leather belting, woodworkers' shop, Gorgona.
5. Schieren leather belting, in Gorgona machine shops.



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3

TYPES OF HIGH CLASS AMERICAN TOOL MACHINERY AT THE CANAL

1. Late design high-duty lathe. Furnished the canal machine shops by the American Tool Works, Cincinnati, O.
2. High grade automatic steam engine furnished by the Buckeye Engine Company, Salem, Ohio.
3. High speed engine furnished by the Ball Engine Company, Erie, Pa.

Corrugated copper gaskets supplied by the Akron Metallic Gasket Company, of Akron, Ohio, were used in large numbers for making joints on steam lines carrying from 100 to 200 pounds pressure, on tugs and dredges in the service of the Atlantic division, and also in the power plant at the dry dock shops on the canal. In making these gaskets precaution was taken to see that faces of flanges were smooth, as those of the irregular surfaces do not give as satisfactory results. In a report to the company, officials of the canal stated that no blowing-out of joints made up in this manner had occurred and that the results obtained were satisfactory. The officials further reported that the tug *Reliance*, belonging to the commission, had a joint made up in this way between the main steam line and the throttle previous to her trip around the Horn to Balboa, and that the joint remained tight throughout the trip.

On account of the extreme dampness of the atmosphere the canal engineers were confronted with problems in the operation of the machine shops at Gorgona and Empire which are not encountered in temperate climates. The steam shovels and locomotives had to be kept going; repairs were made to the shovels on the spot; castings were made for all kinds of purposes; and it was necessary that the shop operations should be continuous and efficient, in spite of weather conditions. Here, as elsewhere in the canal work, minute attention to detail and the application of American methods brought success.

An example of this is found in the comparatively minor item of belting. In the maze of big machinery at Gorgona and Empire, and in face of the stupendous concrete works at Gatun, Miraflores, and Pedro Miguel, the casual visitor would pay little attention to the matter of belting. "And yet," said one of the canal engineers, in discussing the difficulties that had been encountered, "if it were not for the belts what would the machinery amount to? These belts were the very sinews of our shops. They simply had to do their work without regard to heat or dampness, oil, or dryness. A breakdown in these shops on account of poor belts would have meant a stoppage of the shovels and locomotives, a lack of repair parts and castings, and a shut-down of canal work itself.

"We found that ordinary belting would not do on the Isthmus. It stretches with the moisture, and then, when it dries out a bit, it opens at the laps and has to be cut constantly in order to keep it at the proper length to pull the machines. Two- or three-ply belting was very apt to part company and prove worthless as a driver of machinery in this climate.

"We tried several kinds of belting, and finally an American concern, as usual, helped us out by furnishing an article that would stand the test of these severe conditions. The Duxbak belt made by the Charles A. Schieren Company, of New York, we found satisfactory, and over 18,000 feet of Duxbak was installed in these shops and along the canal. It was worked under the most trying conditions and really it is with a great satisfaction that I speak a word for it. We would have been up against a serious proposition if we had not been able to find somewhere in the United States a belt that would do our work. It is a little thing, compared with steam shovels and ocean-going dredges, but if you look into the building of the Panama Canal you will be impressed by the fact that it was attention to the 'little things' that made the big thing possible."

Automatic couplers and parts, and miscellaneous castings for the equipment for new railway cars for work on the canal, and for maintenance and repair of rolling stock already in use were furnished to the Canal Commission by the National Malleable Castings Company, of Cleveland, Ohio, a very large concern which has works in six cities. This company's shipments began in 1906 and continued until the completion of the canal. From October, 1906, to August, 1912, the company furnished 6,000 couplers.

The majority of these couplers were of

the style known as the "Tower" coupler (named after the inventor, Mr. A. C. Tower), of the master car builders' vertical hook type. The couplers were manufactured principally at the company's steel castings works at Sharon, Pa. They were constructed mainly of cast steel, under patents owned by the company.

Couplers of this make have been in use for many years on the railroads of the United States and in Canada and Mexico, during which time their adaptation to the requirements of the service, their simplicity and perfection of design, ease of operation, and durability have been established by experience and by the severe tests to which they were continually subjected.

Recognizing the inadequacy of the old spike to secure the rail to the tie in modern railroading, the government laid all its roadbed in the Canal Zone with screw spikes and tie plates. There are several points of view from which such a practice should be studied. The means of holding the tie to the rail should have the following advantages, which are found in the screw spike tie plate:

It should be strong enough to prevent rail spreading under most severe traffic conditions; it should have a factor of permanence which obviates too frequent necessity for inspection and maintenance; it should minimize abrasion of the tie by the rail; it should protect the tie against the elements as much as possible; and it should be capable of removal and reapplication with a minimum of depreciation.

The original practice of fastening the rail to the tie by the use of a spike driven into the tie, the head of which is in contact with the rail flange, has been found open to several objections.

There are in service two forces acting on the head of the spike—a lateral thrust and a vertical pull. The first is caused by the weight of the traffic being applied against the inside of the head of the rail in such a way as to force the rail against the throat of the spike, this continual action eventually distorting the spike by breaking down the fiber of the tie behind the head of the spike.

The second, or vertical, action on the spike is the result of so-called "wave action" in the rail, and tends to raise the spike from one-eighth inch to one-fourth inch from its original position, until there is very little resistance to the rail spreading.

In addition to these two disadvantages, it is very difficult to drive a spike into a tie properly, and the most common practice necessitates striking the back of the head of the spike after it is driven until a perfect bearing on the rail flange is secured, leaving an opening of about one-sixteenth inch behind the head of the spike. This allows for an initial movement of the spike head, and also for the entrance of the water, which acts on the crushed fibers of the tie, and the tie soon disintegrates at this point. Then, with the friction caused by pulling out the spike on account of wave action, a mechanical wearing takes place between the base of the rail and the top of the tie. Dust from the ballast hastens this wear and greatly shortens the life of the tie.

The practice on the Panama Railroad avoids as much as possible the difficulties mentioned. The tie plate used has a shoulder, against which the outside of the rail flange bears, and bosses which support the heads of the spike on the outside prevent distortion of the spike, which would take place where the spike head is supported on one side only. These tie plates are supplied with screw spikes, for which holes have been bored in the tie.

The holding power of the screw spike in wood has been determined by several tests to be about three times as great as that of an ordinary spike, and when to this advantage is added the boring of the tie in a vertical direction, so that the screw spike is applied under most favorable conditions, and then the support given to the neck of the screw spike by the tie plate, and to the head of the screw spike by the boss on the outside of the spike, a very much more satisfactory condition obtains.













TYPES OF AMERICAN BUSINESS MEN WHO CO-OPERATED ALONG VARIOUS LINES IN AMERICA'S GREAT WORK AT PANAMA

1. William B. Harris, New York.
2. Howard Elliott, Pres., N. Y., N. H. & H. R. R. Co.
3. J. H. Weaver, J. H. Weaver & Co., Phila., Pa.
4. William L. D'Olier, Pres., D'Olier Engineering Co., Phila., Pa.
5. Herman L. Hohlfeld, Pres., Hohlfeld Mfg. Co., Phila., Pa.
6. J. H. Einstein, Pres., Tower Mfg. & Novelty Co., New York.

This is recognized on a great many American railways to the extent of using tie plates and screw spikes on approaches to bridges, on trestles, and around switches, frogs, and crossings. Their use in these places proves that this method of applying rails to ties will stand heavier traffic conditions with greater factor of safety than any other now known. The commission adopted this form of fastening for all of the roadbed in the Canal Zone for the reason that where a railbed is laid, and the maintenance cost is figured with the initial cost, screw spikes and tie plates make economical installation.

The cost of inspection and maintenance has a growing significance in railroad operation, and the greater holding power of screw spikes used with tie plates minimizes the amount of inspection and maintenance necessary to keep railbed in proper condition.

Reference has been made to the abrasion of the tie by the rail, which takes place under ordinary conditions as soon as the spike loosens slightly. When tie plates and screw spikes are used, the pressure of the rail is distributed over a much greater surface of the tie, and the tie plate is fastened permanently to the tie, so that, were any movement possible with this form of installation, it would take place between the rail and the tie plate, neither of which would be injured, and the tie would not suffer as it does now. However, this form of tie destruction is eliminated by the use of tie plates with screw spikes, as no movement takes place between the rail and the tie.

The protection of the tie against the elements where the rail bears is another important advantage gained by the use of tie plates. After the rail loosens slightly from the tie, water seeps in, is forced down into the tie, and soon induces decay. Particularly is this true after the tie has been abraded until there is an open fiber, into which the water is easily attracted. In a broader sense, the use of spikes which need to be redriven at frequent intervals results in "the spike killing the tie," because, whenever the spike is redriven, a new portion of the tie fiber is crushed, and before long such a large part of the tie is decayed that no more firm wood remains into which to drive the spikes. The greater holding power of screw spikes and tie plates removes this necessity for redriving the spikes at frequent intervals.

It is sometimes advantageous to take up a section of track and relay it in a new position. Tests have shown that where common spikes are pulled and redriven, their holding power is decreased to about one-third. Where screw spikes are removed and redriven in the same hole, their efficiency is not affected.

Briefly, then, tie plates and screw spikes are economical on account of the safety factor which they present under most severe traffic conditions; on account of the permanence of installation, and freedom from "upkeep" expense; on account of the longer life of the tie secured by their use; and on account of lending themselves to reapplication.

The screw spike tie plates used in the Canal Zone are known as "Economy No. 9 R. W.," and were manufactured by the Spencer Otis Company, Chicago.

The Pennsylvania Steel Company, of Steelton, Pa., was brought into connection with canal construction through the shipment of steel castings for the racks for the electric locomotives which tow vessels through the locks. These castings were made in 9,261 sections, weighing approximately 717 pounds each, and were shipped to the Canal Zone between January, 1911, and January, 1913.

For their particular work, it was required that these castings be exceedingly accurate. The company had no difficulty in turning them out to the complete satisfaction of the canal authorities.

The S. G. Taylor Chain Company, Chicago, Ill., which supplied steam shovel hoisting chains for the canal, is an old established concern, organized in 1873. While it manufactures a general line of welded chains, it has always paid particu-

lar attention to steam shovel and dredge chain, having supplied it for this very exacting service in all parts of the United States and in several foreign countries. The Taylor-Mesaba chain, the particular brand adopted for work on the canal, is a hand forged chain made from a special brand of triple refined iron, rolled expressly for this purpose. The bulk of chain used was one and one-half inch diameter material, and one hoisting chain of this size for a ninety-five ton shovel weighed about one and three-fourths tons. The Canal Commission specifications required that sample breaking tests of this material should run not less than 134,000 lbs. The tests actually made ran up in some cases as high as 165,000 lbs.

Bolts, nuts, rivets, screws, upset rods, and forgings were supplied for the canal work in large quantities by the Pittsburgh Screw and Bolt Company, of Pittsburgh, both by direct order and through other contractors. This company has for many years supplied the war and navy departments with this class of material.

Another Pittsburgh concern which shipped large quantities of iron and steel forgings and material for the Panama Railroad tracks was the Pittsburgh Forge and Iron Company. In a long list of shipments from this company, extending over several years, track bolts, frogs, and stay-bolt iron, machine bolts, drift bolts, fish plates, knuckle pins, and other equipment were included.

One of the American concerns which more than met the rigid specifications laid down by the Isthmian Canal Commission was the Ross-Meehan Foundry Company, of Chattanooga, Tenn., which supplied large quantities of malleable castings for cars. It also supplied similar castings for dump cars under a sub-contract, and also under sub-contract supplied conduit cover plates and brackets, insulator clamps, and other malleable castings. The conduit cover plates were used on the conduit for the electric towing locomotives.

The record of tests taken showed physical qualities considerably in excess of the rigid commission specifications, and all the work turned out was highly satisfactory, great care having been exercised as to the quality of the crude material. The castings were manufactured in the company's reverberating furnaces and annealing ovens.

Automatically operated valves of latest design for the protection of boilers and their steam lines were supplied in large quantities by the Golden-Anderson Valve Specialty Company, of Pittsburgh, Pa. Double-cushioned, triple-acting, non-return valves designed to automatically protect boilers in case of a bursting tube and to act as a safety stop to prevent steam entering a cold boiler, were among the variety of valves furnished. These valves automatically shut off the steam from every boiler at the instant of a pipe rupture, and immediately cut out a boiler when a tube bursts. The valves can be closed by steam or electricity from any part of the plant, or they may be closed by hand, like an ordinary valve.

The modern plan of centralizing the power plant with its batteries of boilers generating high steam pressures, and particularly where they have a large number of branch lines, has suggested the provision of this automatic safeguard against emergencies. It applies to all power plants in a general way, whether one or many boilers are in service.

Another corporation which supplied valves of various kinds for the canal machinery was the Roe-Stephens Manufacturing Company, of Detroit, Mich.

The E. F. Keating Company, of New York, which carries the largest stock of pipe fittings, valves, and tools in the United States, was one of the concerns which supplied the canal with a variety of materials in its line. Their orders included machines for threading pipe, wrought iron pipe, malleable iron fittings, screwed and flanged fittings, plumbing supplies, and steel and iron parts of infinite variety.

The O. F. Jordan Co., of Chicago, Ill., specialists in railroad construction and

maintenance equipment, furnished the canal authorities with iron and steel material, in the form of spreaders, unloading plows, cast steel, and manganese crossings. A number of the full pneumatic-control Jordan spreaders, manufactured by this company, were used on the Panama Canal, and gave great satisfaction. The spreaders were used in leveling, spreading, and ditching material along the canal route, and their easy disposal of heavy rocks was one of the features of their work. The spreader has many uses. In cold climates it renders efficient service as a snow plow, and it is generally used in construction work where the moving, leveling, and spreading of material is necessary.

Wrought iron washers for binding bolts were supplied to the Canal Commission during the entire period of construction by Henry A. Hitner's Sons Company, of Philadelphia, Pa., dealers in iron, steel, and metals. The washers were manufactured from new plates, under power pressure and were all found flat and true to center.

Steel and copper hose for steam, air, water, and oil transmission was supplied for the canal by the Pennsylvania Flexible Metallic Tubing Company, of Philadelphia. This hose was for use under the highest pressures, and was particularly suitable for rough usage. As it was made entirely of bronze, with asbestos packings, it was unaffected by the temperature or general climatic conditions at the Isthmus.

The company's shipments to the canal continued until the completion of the work. In the period from the latter part of 1908 to the beginning of 1912, the shipments of tubing, steel sectional hose, brass conduit hose, and copper hose of various sizes totaled nearly six miles in length.

The Boston Belting Company, of Boston, Mass., began to furnish articles of its own manufacture to the Canal Commission in November, 1908, and continued with other contracts as late as April, 1912. Among the supplies sent were thirty-three dredging sleeves; "Imperial" stitched rubber belting; brass wire insertion sheet packing; and 5,000 feet of special cotton jacket fire hose, coupled with heavy expansion ring couplings, Chicago fire hose thread.

The numerous pumps and engines on the Isthmus required large quantities of rubber sheet packing for flanged joints, and flax packing for pumps. Large quantities of this material were furnished by the Home Rubber Company, of Trenton, N. J. The company also supplied a large quantity of rubber hose.

Another firm which supplied great quantities of rubber in the form of water, steam, air suction, and fire hose, and dredging sleeves and belting, was the Boston Woven Hose & Rubber Company, of Boston, Mass. In the period between 1908 and 1912 this company supplied the canal authorities with nearly ten miles of rubber material, and continued to supply additional material until the completion of the work.

The Manhattan Rubber Manufacturing Company, of Passaic, N. J., was another firm which supplied the canal with steam, air, water and fire hose. This firm is a large maker of mechanical rubber goods, and its articles supplied to the canal were the regular commercial qualities and sizes, common throughout the United States.

Still another concern which furnished a varied assortment of rubber equipment for the canal was the Voorhees Rubber Company, of Jersey City, N. J., manufacturers of high grade mechanical rubber goods, including hose, belting, packing, valves, tubing, and "Nubian" packing and gaskets.

The Republic Rubber Company, of Youngstown, Ohio, supplied water, steam, air and suction hose for the canal. This was used in the general construction work, the company's shipments beginning in 1905 and continuing until the completion of the canal. The hose turned out by this company was of special construction adaptable for tropical climates and was manufactured under the Canal Commission specifications.

The Cobb Engineering Company, formerly the Rawles-Cobb Company, of Boston, Mass., dealers in factory and machinists' supplies, marine hardware, and special mechanical tools, continually figured in shipments of varied equipment to the Canal Zone during the whole construction period. This concern for many years has supplied the Navy and War Departments with different lines of equipment, its shipments going to every navy yard in the United States, and to the Philippines.

With reference to the canal, the company figured regularly in all miscellaneous hardware and general tool supplies, its shipments going by nearly every steamer. It also furnished the coal tar for the Canal Zone roads, and each year was awarded the contract for wrenches and kindred tools.

Among big firms furnishing vast quantities of varied equipment for the canal was the old established and widely known Crane Company, of Chicago. The materials supplied to the Panama Canal by this firm composed a great number of shipments, from the beginning of the canal work to its completion. The first order, which approximated more than 1,000,000 pounds, consisted of a large quantity of standard and extra heavy flanged fittings, screwed fittings, and standard and extra heavy iron and brass gate valves, with pressures running from 100 to 250 pounds. The company also supplied many thousand brass globe and angle valves, principally of the regrinding type. Besides its own manufactured product, the Crane Company supplied for the Canal Zone several hundred bath tubs, more than 1,000 enameled lavatories, and several hundred enameled sinks and sanitary combinations. The valves and fittings were used in the equipment for conveying water, air, and steam, during the construction work, and the other material was used in the plumbing and equipment of the various buildings.

Machinery furnished by Fairbanks, Morse & Company, of Chicago, played a rather important part in the construction work of the canal. A various assortment of material and equipment was shipped. Some of the most notable, which aided in facilitating the construction work, were the hand and push cars, gasoline motor cars, and velocipedes. Of the hand and push cars over 300 were supplied, together with a large lot of velocipedes and gasoline motor cars, the latter being employed mostly for inspection work. Several of these gasoline motor cars were of the larger type, having semi-elliptical spring mounting, with canopy top and glass vestibule front, with a seating capacity for nine people, and were used principally by officials of the commission on their tours of inspection.

Ten water tanks to supply water to the locomotives were furnished, together with the same number of standpipes for delivering the water from the tanks to the locomotive tenders where the tracks were removed some distance from the tank, also a large number of steam pumps for delivering the water from source of supply into these tanks. Many steam boilers were used for generating steam for various steam engines and pumps throughout the works, and for feeding water into these various boilers, Fairbanks, Morse & Company supplied a large number of feed pumps, of various sizes and capacities.

Over 21,000 short handle shovels were furnished to the commission by Fairbanks, Morse & Company. Much of this material which was used during the construction of the canal, will, of course, be used in connection with its operation.

One of the firms which supplied the greatest variety of general equipment for the canal was T. S. Banks and Company, of New York. This firm in the period from May 15, 1905, to July 15, 1912, filled 258 contracts for the canal, calling for 147 kinds of equipment and merchandise. It continued to fill further contracts up to and following the completion of the canal. The equipments shipped varied from a number of dredger buckets used in digging the canal to a bewildering variety of tools,

implements, harness, wagons, wheels and other supplies even down to needles.

Surveying and Other Scientific Instruments and Materials

Before the actual work of construction began, appliances which have been brought to a high state of scientific precision by American inventive genius were busily engaged all along the canal route. These were the surveying instruments, which in the hands of the engineers, enabled them to map out in advance the exact details of the work that was to come. Aneroid barometers of American make early found employment in taking gradients along the Canal Zone, and other instruments of precision did their part in preliminary work.

In the prosecution of survey work at the Isthmus, the Buff & Buff Manufacturing Company, of Jamaica Plain, Boston, Mass., was early in the field, supplying the triangulation theodolites that were used in surveying, leveling, complete triangulating and all manner of measuring details. Their contracts extended over a period of five years and comprised numerous orders.

The instruments of the Buff & Buff Manufacturing Company were selected as the result of competitive tests, in which their product proved superior in design, workmanship, and accuracy, the engineers finding them particularly satisfactory because of their ability to withstand great heat and excessive moisture. The evolution of this finished instrument embraces a long series of modifications and improvements in mechanical detail, from the Stackpole transit of sixty years ago to the Buff & Buff transit of today. The old firm of Stackpole & Sons, of New York City, manufactured the instrument that, in its day, was used and demanded by the best engineers on all the large surveys then being made. George L. Buff was foreman of that concern, and it was his handiwork that gave the instruments their reputation.

The principal characteristics of the old Stackpole transit that differentiated it from the cumbersome English theodolite were the increase in power and freedom of motion of the telescope, the greater rigidity secured by mounting the telescope axis in double cone bearings, the introduction of a coarser horizontal graduation reading to single minutes that permitted greater speed in reading and at the same time decreased the liability of error, and important improvements in the construction of the centers and graduations.

In 1871 George L. Buff left the firm of Stackpole & Sons, and established a business in Boston, where he designed and constructed the first Buff & Berger transit, using the old Stackpole instrument as a basis and adding to it numerous improvements gleaned in research work. His personal skill, together with the use of special bronze mixtures for the different bearings and parts, brought to the Buff & Berger transits a reputation that grew steadily for twenty-seven years.

The partnership formed in 1871 was dissolved in 1898, when Mr. Buff and his three sons—all of them technical graduates—established the Buff & Buff Manufacturing Company. Again the transit was taken in hand, and nearly fifty distinct improvements were incorporated in the new design. It is this finished product, representing fifty-seven years of close application and hard work on the part of the senior member of the firm, that was used at the canal. Of the large number of instruments furnished, not one failed to give satisfaction.

Many of the large number and variety of instruments manufactured by C. L. Berger & Sons, of Boston, Mass., were in daily use on the Isthmus, during the survey and development work, notably levels and transits. This firm, well known in its particular field, was founded in 1871, having been reorganized under its present management and control in 1898. At its present location, at 37 Williams Street, it has established a specially designed plant for making engineering and surveying instruments of the highest accuracy. The principal output consists of transits and

levels, which are sent to all parts of the world wherever American engineers are engaged in active practice. Over 10,000 of these instruments have been used in the various lines of railway, canal, and tunnel construction, topographic surveys, and general base line and boundary line determinations.

The mechanical features of its transits and levels are especially adapted to work under all conditions of temperature and climate, which largely accounts for their popularity and the unqualified satisfaction which followed their employment on the canal. In addition to the regular type for civil engineers' use, others have been devised for special use, as in iron mines where a compass could not be employed, in dripping mines, for mountain work, and for triangulation. For mining work numerous accessories have been invented in order to enable engineers to solve the complicated problems encountered under the surface of the ground. The wet mine transit, for example, is designed to protect all working parts from corroding gases, as well as from dripping water that often contains acid or alkaline properties. Other contrivances are especially adapted to deep shaft work, while its light mountain transit has in view conditions of reconnoissance work in which lightness of weight combined with high telescopic power is of great importance. These, together with many other specially designed features are found in the instruments of this company, and have been introduced not as novelties, but for practical use to enable engineers to accomplish the maximum amount of work in the shortest time, and with the greatest ease and highest degree of accuracy.

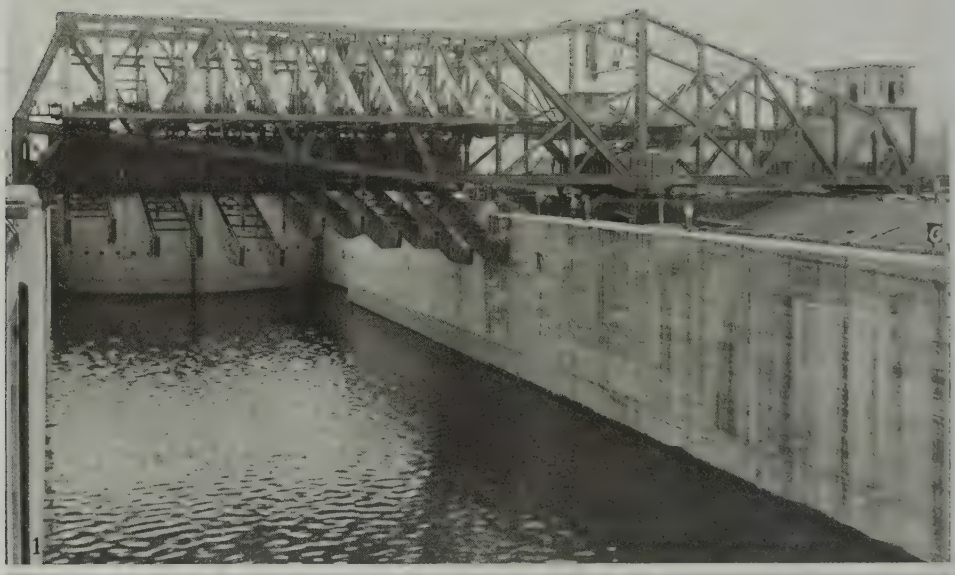
Besides supplying apparatus through other agencies, the Hohmann & Maurer Manufacturing Company, with headquarters in Rochester, N. Y., and branch offices in Boston, New York, Chicago, and London, made numerous shipments of its scientific and engineering instruments direct to the Canal Commission at the Isthmus.

These instruments consisted of various sorts of thermometers,—gas, superheated steam, feed water, flue gas, and refrigeration thermometers, and a number of aneroid barometers, the direct shipments being made on contracts entered into in 1911. Most of the thermometers were for the power plant at Miraflores, while the barometers were sent to the Isthmian Canal Commission's dock at Colon. The Hohman & Maurer Manufacturing Company also supplied indirectly a number of special vacuum gauges, which were used in connection with the equipment of the steam plants furnished by other companies that had contracted for outfits as a whole.

The instruments of this company have a world-wide reputation for careful construction and perfect accuracy. As temperature measurement and control in modern refrigeration as well as in steam plants are vital factors in their economical and successful operation, the selection of Hohmann & Maurer thermometers and gauges by the canal officials furnished its own guaranty of their superior excellence. The same may be said of the Short & Mason aneroid barometers furnished by this firm and made by the Short & Mason division, which found service in ascertaining variations in gradients and levels along the course of the canal, as well as in determining the elevations of the hills and mountains of the surrounding country.

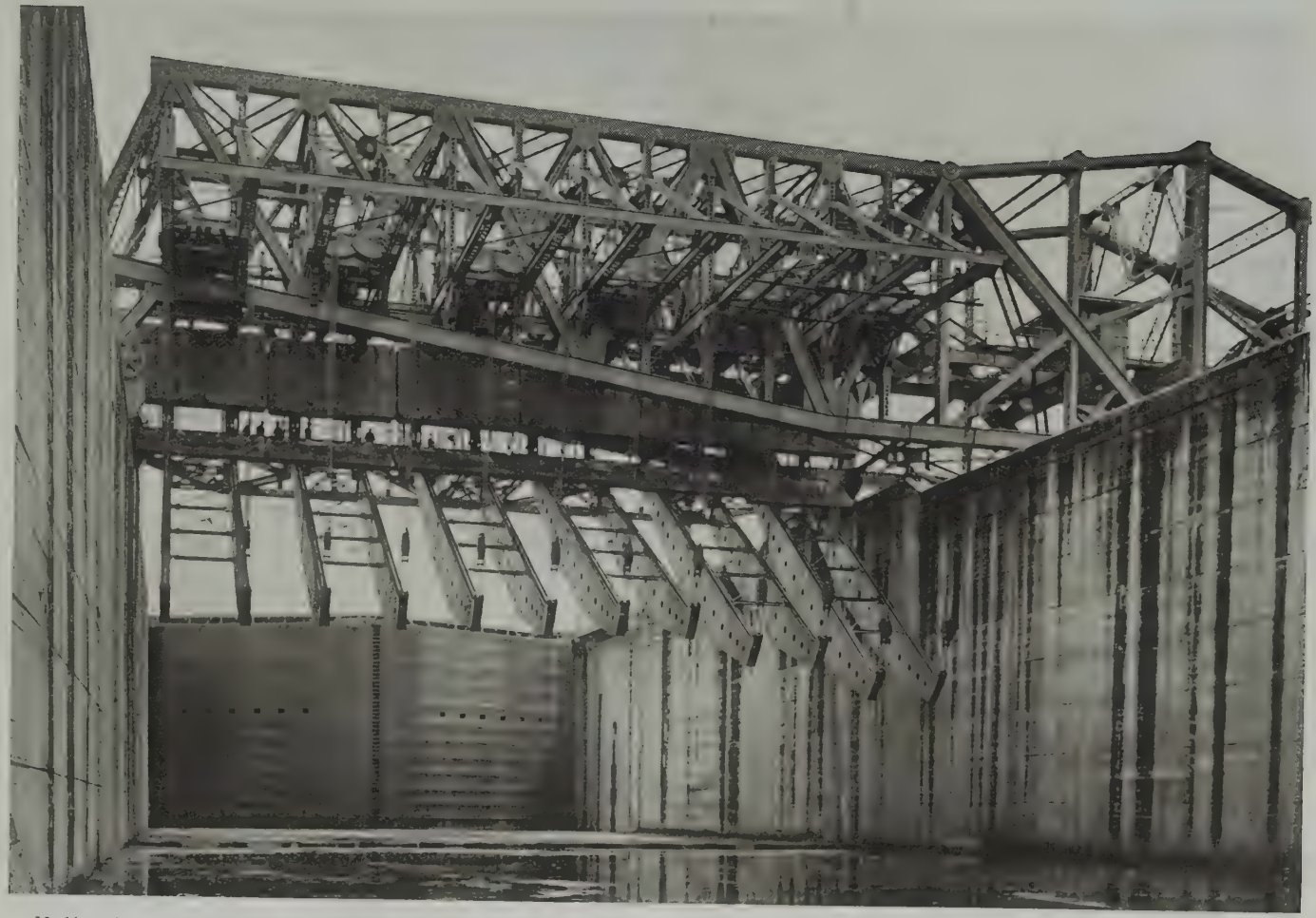
The Hohmann & Maurer Manufacturing Company is a division of the Taylor Instrument Companies. Mr. J. M. Taylor is president, and Mr. H. J. Winn treasurer of the controlling concern.

Among the successful bidders for furnishing materials used in the office and draughting departments at the canal, as well as in the survey work, were F. Weber & Company, of Philadelphia, Pa., manufacturers and importers of artists' materials and draughtsmen's and engineers' supplies. Their shipments included miscellaneous articles, all of their own manufacture, such as non-deteriorating waterproof India inks, water colors, the "F. W. & Company's and Riefler Tubular Round System" drawing instru-





1. Emergency dam at Gatun. Normally this dam is pivoted on the side wall, parallel with the lock instead of across it. When accidents occur it will be swung across the lock, the steel wicket girders let down, as in the upper picture, and great sheets of steel let down on them, as in the lower picture, thus completely closing the lock.



Machinery for operating the lock emergency dams.
(Otis Elevator Company, New York.)

ments, blue and brown print papers, and other office supplies, and engineers' and mining surveying instruments. These supplies were extensively used at the Isthmus, and gave thorough satisfaction both in clerical and in field operations.

Another prominent firm which supplied mathematical, engineering, and surveying instruments for the canal experts was Heller & Brightly, of Philadelphia, Pa., makers of instruments of this kind. In addition to other instruments, a number of the firm's transits and levels were furnished to the canal authorities. The president of the company is Charles W. Heller, a native of Philadelphia.

Nearly all of the blue prints prepared for the canal were made on paper supplied by Williams, Brown & Earle, Inc., of Philadelphia, one of the leading, as well as one of the oldest, of the manufacturers of engineering and scientific instruments in the United States. This firm also supplied the two washing and drying machines and the two blue-printing machines that were sent to the Isthmus. These machines, equipped with electric lamps, motors, and dryers, were so constructed as to wash and dry the prints in a single operation at the rate of four to six linear feet a minute. At its full capacity the machinery provides for the production of completed blue prints fifty-four inches wide and of unlimited length. During the year 1912, Williams, Brown & Earle furnished about 50,000 yards, or nearly thirty miles, of blue print paper for the use of the engineers on the canal, in making blue prints for construction work.

The firm manufactures its own machines for photographically coating its paper, either by the blue print or other photographic processes. The paper is coated with special care and then packed in metal tubes, to prevent decomposition and change in the photographic surface liable to occur in the tropics. Other scientific apparatus was furnished by this firm for use in various lines of scientific investigation, as well as for the purpose of furnishing entertainment and amusement to those residing along the canal during its construction.

The firm of Ernst Leitz, of New York, N. Y., supplied microscopes and laboratory materials for use in medical diagnosis and the examination of the water supply that was carried on in connection with the sanitation work at the canal, for the protection of health and maintenance of suitable living conditions for the immense army of workers. The Leitz microscopes are manufactured at the firm's factory in Wetzlar, Germany. Their instruments were first introduced in 1848, and have obtained extensive use in critical research work in the laboratories of governmental and educational institutions all over the world.

Oiling the Machinery

The vast quantities of lubricating oils used in canal construction give an inkling of the tremendous mechanical powers at work on the Isthmus.

Contracts with the Canal Commission for furnishing lubricating oils and other related materials were first made in May, 1910, by the Texas Company, with general offices in Houston, Texas, and New York, and were followed by numerous renewals. The total of these contracts up to June, 1913, reached the high figure of 824,000 gallons of the various kinds of lubricating oils, and 448,000 pounds of the greases manufactured by the company, with lesser shipments of kerosene and gasoline in addition. Shipments of these materials followed immediately after the original award, and have been in progress monthly ever since.

The samples furnished by the Texas Company were submitted to critical laboratory and practical tests, and successfully withstood them all. The adaptability of "Texaco" lubricants was proved by their action under the severest construction conditions, in which lubricating problems were encountered of a nature that are exceedingly difficult to overcome. Some idea of these difficulties may be obtained from the statement that the canal dipper

dredges often were worked under thirty feet of water, and had to be kept properly lubricated while so submerged. The railroad equipment, also, was often compelled to be kept moving with mud and water up to the wheels, axle boxes, and other parts of the machinery usually protected from dampness and grit. Not only did the oils of the Texas Company meet these deterrent obstacles, but they also earned the approval of the canal officials under conditions that required the greatest economy, as well as continuous service for thousands of hours without cessation or breakdown. The report of the commission for 1911 showed that in all the power plants where this lubricant was used, not a stoppage was made on account of a heated bearing or any other lubricating trouble during the whole year. The oils were also used generally on locomotives, cars, dredges, steam shovels, and, in fact, all the machinery employed on the Isthmus. The company manufactures its lubricants from various crudes, each best adapted to the special grade of oil or grease desired. This work has called for a special study of oil refining in order to meet the required commercial conditions, and has also resulted in the designing of much special equipment to achieve the ends in view. The established facilities of the company in the way of ocean terminals and storage sites met all requirements for quick transportation of its products to Panama.

One of the oldest firms which had a part in the construction of the canal was the Crew-Levick Company, of Philadelphia, Pa. This firm recently celebrated its fiftieth anniversary, and is one of the oldest refiners of petroleum in the United States. The company was well known to the United States Government as well as the governments of the European and Asiatic countries before the beginning of canal construction, and after the commencement of the work was a constant supplier of large quantities of cylinder engine and dynamo oils to the Isthmian Canal Commission. In addition to its wide foreign business the company has always enjoyed a very large domestic business, making a specialty of high-grade products meeting all the demands of the manufacturing industries, and distributing them through their many branch offices to all parts of the United States. In recent years the company has made a specialty of motor oils, and this department has developed rapidly. All of the plants of the company are located in Pennsylvania, and in addition to its United States agencies it has agencies all over the world in all the principal business centers, its largest export trade being from the ports of Philadelphia, New York, and Baltimore. The company was one of the earliest in the United States to realize the great possibilities of trade expansion in foreign fields. Its first foreign branch was established in Liverpool nearly forty years ago, when Mr. Levick ascertained that a great market awaited the company's products in Europe. Since that time Mr. Levick has made almost yearly trips abroad, and the export business of the company, growing steadily in volume, has for many years been a beacon to other American lines of industry in pointing out channels to foreign trade.

W. N. Best, of New York, engineer in caloric, supplied the commission with oil burners, oil furnaces, and fire brick for relining. The oil burners were used for steams boilers of all types and sizes in power plants, dredges, etc. The furnaces were used for bolt making, rivet heating, forging, welding, plate heating, and other purposes. The burners supplied by Mr. Best were specially adapted for using the California fuel oil. About 200 burners were supplied, with twenty-one furnaces.

Early in 1912 certain achievements in increasing the life use of metals, by the Whitmore Manufacturing Company, lubricating engineers of Cleveland, Ohio, came to the attention of the Isthmian Canal Commission, and thereupon the commission requested from the Whitmore Company full details regarding their special work in lubricating, together with statistics

of past performances, and samples of their material for testing purposes.

Upon request representatives of the Canal Commission furnished the Whitmore laboratories minute data regarding the requirements of lubrication in the canal works. In brief the data furnished gave the following requirements:

Lubrication was required for the center pivot bearings and the roller bearings of the emergency dams. The nature of the service was very unusual, and offered a very difficult problem. The center pivot bearings are constructed with three discs, forty-three inches in diameter, the upper and lower discs being of forged vanadium steel, with concave bearing surfaces, hardened to test eighty-five to ninety on the sclerescope, and the center disc of forged manganese bronze, having an elastic limit of 90,000 pounds, surfaces convex, with five grooves radiating from a two-inch hole through the center to within one-fourth inch of the circumference, by means of which the lubricant is conveyed to the bearing surfaces during the period of movement only. The lubricant is forced through twenty feet of one-inch pipe to the two-inch hole in the center by means of a screw compressor on the floor of the dam.

A total weight of 6,700,000 pounds rests on each bearing, being a unit of pressure of 4,620 pounds to the square inch. As the emergency dams are operated only once in thirty days for testing, there are rest periods of twenty-nine days during which the pivot bearings must support the entire 6,700,000 pounds weight. A lubricant, therefore, must be employed which will have the capacity of holding the bearing surfaces definitely apart during those twenty-nine day rest periods of super-excessive pressure, because if not definitely apart at the initial moment of the movement, the bearing will stick and cut, and the dams lose their value for emergency purposes.

The problem in connection with the roller bearings was that of protection of the polished steel under the excessive corrosive conditions prevailing on the Isthmus.

With complete data regarding the conditions of the service in their possession, the Whitmore laboratories set to work on the problem, and developed a product especially to meet the requirements. Tests of the Whitmore product were conducted by representatives of the Isthmian Canal Commission under reproduced conditions. These tests showed phenomenal results. Whitmore's anti-friction composition, made especially for this purpose, not only withstood the required pressure of 4,620 pounds, but was subjected to units of pressure as high as 13,300 pounds to the square inch, with the bearing parts definitely apart, and the lubricant still capable of indefinite further expansion; and providing a factor of safety in the starting coefficient of over 700 per cent. compared with the best foreign greases submitted for tests.

Expert commission men, who stocked the chain of government stores of the Panama Canal Commission, recognized in advance that they had a mighty rust problem to contend with, just as the sanitation department had to face the mosquito and yellow fever problem.

Tropical rains in torrents and moist salt air spelled rust, corrosion, and verdigris on everything metallic in the Canal Zone, unless carefully protected. That protection was afforded by oil, the product of the Three-In-One Oil Company, of New York. It was used on guns, revolvers, sewing machines, typewriters, ice-cream freezers, bolts, locks, clocks,—everything made of metal, in-doors or out.

"Three-in-One," the conqueror of rust and corrosion, was put in every store from the Atlantic to the Pacific. The members of the commission used rust-preventing "Three-in-One" oil for their razors, reels, golf clubs, and other personal property, as did the humblest worker in the zone. And the record that this trouble-dispeller made along the canal was notable.

No one appreciated "Three-in-One" more than the soldiers and marines. It kept their arms and accoutrements in perfect condition, thereby saving money for

Uncle Sam, as well as saving the soldiers' and marines' time, temper, and energy. It helped every one, every day, to stand up to their severe tasks under climatic handicaps. "Three-in-One" not only fought off rust and corrosion but it also oiled every kind of light mechanism or device, and kept veneered and varnished furniture and woodwork.

William W. Nugent & Company, of Chicago, supplied oiling devices for the machinery on the canal. Several shipments were made of Nugent's patented oil system for steam and gas engines and refrigerating machines. Among these were the Nugent patented anti-stand crank pin center oiler, the Nugent anti-packed telescopic positive feed crosshead and top guide oiling device, Nugent oil pumps, oil tanks, and oil filters, and automatic water separators. The superiority of these machines was in guarding against the waste of oil.

With the largest plant in the world devoted to the manufacture of lubricating devices, the Detroit Lubricating Company, of Detroit, Mich., furnished great quantities of hand oil pumps for machines operating on the canal. These were in the form of glass and brass body push pumps, and other forms of lubricating devices. These push pumps were manufactured without springs, and thus were less liable to weakening because of heat and wear.

The Keystone Lubricator Co., of Philadelphia, Pa., furnished large quantities of lubricants to the canal.

Fuel Supplies

The prosecution of any engineering work of the magnitude of the Panama Canal would be impossible without a continuous and uninterrupted supply of fuel, required by the modern steam-driven machinery that played such an important part in the canal's construction. The absence of any coal of commercial value nearer than the United States presented to the canal officials the problem of obtaining and transporting to the Isthmus huge quantities of coal of suitable quality.

To avoid all possibility of delay or complete stoppage of work, an unfailing source of supply from responsible shippers was imperative, and coal capable of being stored under severe climatic conditions without deterioration, and not liable to spontaneous combustion under the tropical sun, was required. In this phase of the canal work, Castner, Curran & Bullitt, Inc., of New York, had a large part.

The conditions comprised in the specifications for coal of necessity limited the choice of fuel to the best to be found in America. This fuel proved to be the Pocahontas and some of the New River coal of West Virginia.

The following letter from Mr. E. A. Drake, vice-president of the Panama Railroad, who had full authority in purchasing all coal for use on the Isthmus, sets forth the coal situation:

New York, Sept. 27, 1912.

Mr. Lemuel Burrows, Jr., Vice-President
and General Manager,
Castner, Curran & Bullitt, Inc.,
1 Broadway, New York City.

Dear Sir: Complying with the request contained in your letter of the 21st inst., I take pleasure in saying that this company's relations with your company, in maintaining our coal supply at the Isthmus, for many years have been intimate and most satisfactory.

From 1895 to 1901 you furnished practically all of our Isthmus coal requirements, which during that period increased from 10,000 to 40,000 tons; and, subsequently, by 1906, to 180,000 tons annually.

We felt justified in dealing almost exclusively with your firm during those years, because you were the chief purveyors of first quality "Pocahontas" coal, classed in naval circles as highest in efficiency, which rating was verified by results we obtained on the Isthmus.

When our necessities increased so that there was justice and propriety in the claim by other firms, who had entered the Pocahontas and New River fields, that they were entitled to participate in the business of supplying our wants, sharp competition in price and quality was inaugurated.

Our fuel necessities increased for 1907 to 375,000 tons, and that quantity was, in effect, divided between your firm and the Berwind-White Coal Company; later our purchase increased to 500,000 tons per annum, and other large firms secured a share of the business.

During the years from 1895 to 1911, in which your firm supplied all, or the larger part, of our requirements, the character of your coal was such that it

uniformly met our B. T. U. specifications, and in use satisfactorily passed the various tests of its handling in railroad and canal construction work on the Isthmus, and in bunkering our own vessels, United States war vessels, and those of our co-carriers at that point.

It was subjected to very many trials, being stored in enormous quantities, under severe climatic conditions, without perceptible deterioration.

Uninterrupted progress of canal work often depended upon your zeal and coöperation, under your contract, in aiding us to keep up our Isthmus coal supply, at times under extreme difficulties of production at the mines and dispatch from loading point. I refer, with peculiar satisfaction, to this phase of our relations, as a dearth of fuel on the Isthmus at any time would have been regarded as a national disaster.

You are aware it is against the policy of this company to furnish testimonials, but I consider writing such a letter as you request an act of simple justice, in recognition of the integrity, helpfulness, and cordiality of your relations with this company over an extended period.

Yours truly,

E. A. Drake,
Vice-President.

From April 1st, 1911, the fuel needs of the Isthmian Canal Commission and the Panama Railroad were largely supplied under contract with the original Pocahontas coal produced by the Pocahontas Consolidated Collieries Company, Incorporated, and from a few other coal mining operators in the Pocahontas and New River fields of Virginia and West Virginia.

Contracts for the supply of more than half a million tons annually for the work on the canal were awarded to the Pocahontas Fuel Company, of New York City, the selling agent of the original Pocahontas producers. The first contract was for one year from April 1st, 1911, and such was the satisfaction given that on the first of April, 1912, a second contract was awarded for the entire estimated period for the completion of the canal, namely, to October 1st, 1914.

The producers of this coal congratulate themselves that their fuel as a power producer was a strong factor in the remarkable record of construction at Panama.

Pocahontas coal is produced in southwestern Virginia and southeastern West Virginia within a distinctly limited area, where, however, there are more than a billion tons of this coal still available for mining. Mining was first commenced at the famous Pocahontas Baby Mine, which is still operated, in 1882, and since that time the opening of new collieries has proceeded steadily until almost the entire Pocahontas field is being mined. The Pocahontas Consolidated Collieries Company alone has nineteen mines in full operation, the output of which is nearly thirty per cent. of all Pocahontas coal marketed. The officers of this company are Isaac T. Mann, president; Charles S. Thorne, first vice-president; Jenkin Jones, second vice-president; James Ellwood Jones, general manager; and George W. Woodruff, secretary and general counsel.

The Panama Railroad, buying for itself and the Isthmian Canal Commission, in 1911 awarded its entire contract of 550,000 tons a year to the Pocahontas Fuel Company, impelled thereto by two reasons,—that it might get the greatest power efficiency from its engines and machinery, and because the Pocahontas Fuel Company, having control of a greater and more certain output than any other Pocahontas and New River selling agency, would be able to supply the quantity and quality of coal contracted for promptly on the arrival of the colliers.

In this connection it is interesting to note that the unequalled quality and output, combined with the ability of the company to give prompt despatch to vessels reporting at bunkers for cargoes of coal, has made it possible for the Pocahontas Fuel Company to invade the markets of Europe, South America, and the west coast of Africa.

Original Pocahontas coal is known as a "smokeless" coal for the reason that it has so little volatile matter in it, and also because this volatile matter readily burns in the furnace or firebox, and thus produces heat instead of escaping into the air as gas and smoke. It has been in use in the navy for many years and is sent in large quantities to the Pacific coast for naval purposes.

Among those coöperating in the construction of the canal through the shipment of supplies were J. H. Weaver & Company, mine owners and coal dealers, with general offices in Philadelphia and New York. From the beginning of operations this company sent large quantities of bituminous coal to the Isthmus. As they confined themselves exclusively to the sale of their own coal, they give personal supervision to the mining and shipping of their orders, and consequently filled all orders with the Canal Commission satisfactorily and with dispatch. The mines of the company are located on three great coal-carrying railroads—the New York Central, the Pennsylvania, and the Baltimore and Ohio—with shipping piers at New York, Philadelphia, and Baltimore. A large proportion of their coal output is especially adapted to steamship, manufacturing, and power house use, and for general steam generating purposes, although they have other mines that furnish coal suitable for locomotives. Their success at the canal has already served them well by greatly increasing their foreign exports of their own high grade, low ash coals.

The Canal and Petroleum Products

The full effect of the completion of the Canal upon the petroleum commerce of the world is yet a question of surmise, and will not be definitely settled until the European war is ended, and commerce has resumed its normal trend. The adjustments that will follow the war may in themselves lead to great changes in international trade in petroleum, particularly depending on what the status of the Dardanelles will be at the conclusion of the war.

A study of the map of the world and its petroleum producing and consuming countries is suggestive of many interesting possibilities. The canal brings the markets of the east and west coasts of the United States in readier contact, subjecting commerce in petroleum to the fluctuating production and values of the eastern and western oil fields. The mid-continent oil fields may find an outlet through the Gulf of Mexico and the canal to the western countries of South America and a number of important Oriental markets. Mexico may find a similar outlet for its petroleum, while Peru may ultimately seek European markets via the Canal. If the end of the European war leaves the Dardanelles open to Russia, petroleum and petroleum products from the great Russian and Roumanian fields may use the canal as a connecting waterway to Oriental markets, while on the other hand, the petroleum interests of the Dutch Indies may utilize the canal in seeking the great consuming markets of Europe. In this country, the Standard Oil Company, with its extensive fleet and ramifying foreign commerce will use the canal extensively in its trade, and will be keenly interested in the canal's effect upon the trade of foreign oil producing countries.

To the canal work itself, American petroleum contributed no less than five important manufactured products, distinctly different, but all essential to the work of constructing the canal. Of these gasoline and kerosene held the lead, while petroleum lubricants, greases, and candles were used in great quantities.

As an indication of the importance of petroleum in the canal work, the Standard Oil Company in the six year period from 1908 to 1914, delivered to the canal authorities 2,400,000 gallons of kerosene and 700,000 gallons of gasoline. This amount of gasoline would enable an average automobile to make nearly 200 trips around the world.

It is expected that the Canal Zone itself will become one of the world's great entrepôts for fuel oil to meet the requirements of merchant and naval ships, with constantly increasing facilities for the storage of all petroleum products required to feed the commerce of the canal and the growing markets accessible thereto.





1. One of the 57 A-G-A buoys used exclusively in lighting the canal.
2. Canal lighting and buoying rear tower, Pacific entrance, looking Northeast.
(American Gasaccumulator Company, Philadelphia, Pa.)

Lighting the Canal

In its great work the Canal Commission called to its aid the discoveries of modern science, not alone in the work of actual construction, but to safeguard life and property, and expedite the transferring of vessels from one ocean to the other. Nothing was left to chance, and so far as human intelligence and foresight could provide, all possibilities of accidents were eliminated. The commission, too, kept in sight the importance of so completing the work that the cost of future maintenance would be reduced to the lowest possible figure.

One of the great discoveries of modern science is that of acetylene, which as an illuminating agent surpasses all other gases used for lighting purposes. The lighting power of acetylene is five times that of the richest oil-gas, which formerly was extensively used for lighting aids to navigation.

Acetylene was well known for its superior and brilliant light, but it was not until the French chemists, Claude and Hess, in the nineties, made their discovery of the dissolving capacity of acetone that it became possible to store large quantities of acetylene under pressure in an entirely safe manner.

The dissolved acetylene has been utilized by the commission in lighting the canal, for the purpose of safeguarding navigation, so that the route is as safe at night as in daylight.

The American Gasaccumulator Company of Philadelphia, at a total cost of $189,933, installed along the line of the canal fifty-seven acetylene light buoys, eighteen front and rear range lights, and a small number of beacons, all of which are the AGA system.

From the Atlantic to the Pacific, or throughout the canal, a double row of these buoys mark the channel, which is further defined by the range lights and beacons, each having its own characteristic.

The buoy consists of a cylindrical floating steel body of eight feet diameter, surmounted by a steel frame which supports a lantern with lens and flash-light apparatus at a height of about fifteen feet above the water level. The draught of the buoy is about twelve feet and it is moored on its station by a heavy chain and sinker.

The source of light is an acetylene flame of about forty Hefner candlepower, which through the lens will develop a lighting power of about 400 Hefner candles, giving a range of light of about eleven and one-half nautical miles in clear weather.

The acetylene for each buoy is stored under 150 pounds pressure in four tanks, known as accumulators, each accumulator being inserted in a pocket of the buoy body from which it may be easily withdrawn when empty and replaced by a fully charged accumulator without taking the buoy out of the water.

The most prominent features of the AGA system are the flasher, the sunvalve, and the accumulators. The AGA flasher gives any desired characteristic, thereby eliminating the possibility of mistaking one light for another, and also distinguishing it from fixed lights on shore. The flasher is acted upon by the pressure of the gas, and delivers automatically after a prefixed interval a quantity of gas to the burner, where the gas is lit by a small pilot flame.

The flasher can be set to give as many as 55,000 separate distinct flashes from one cubic foot of acetylene. The saving of gas effected by this apparatus depends upon the light period compared with the total period; *i.e.*, the light plus the dark period, which is generally known as the "luminous time." For instance, with a luminous time of one-tenth, *i.e.*, .3 seconds light plus 2.7 seconds dark, the saving of gas will amount to ninety per cent. Thus this light consumes only ten per cent. of what a steady light would require.

An apparatus known as the sunvalve has been employed on range and beacon lights, in order to obtain further economy over that gained by the flasher. Its construction is based on the well-known law that a dark surface will absorb more light

than a bright one, transferring the luminous energy into increased molecular action. The sunvalve is therefore composed of one copper cylinder coated with lampblack, and three rods which are made light-reflecting by being gold-plated. When full daylight appears, the black cylinder absorbs light and expands, thereby closing a valve controlling the flow of gas to the installation. This valve remains closed until, for one reason or another (sunset, fog, heavy clouds, etc.) there is no more light to be absorbed, when the black cylinder contracts, and the valve, acted upon by a spring, opens again, allowing the gas to pass, and causing the light to flash.

The saving effected by this apparatus is about forty per cent. of the gas consumption of the burner, and the saving obtained by employing the flasher with a luminous time of one-tenth, together with a sunvalve, is about ninety-four per cent., compared with steady light.

The gas used by the AGA system is stored in seamless steel tanks, which are completely filled with the AGA porous mass, entirely eliminating from the gas its explosive qualities. An accumulator thus prepared has the power to absorb a quantity of acetylene in dissolved form equal to 100 times its own volume at a pressure of ten atmospheres. This large amount of gas is available at all times.

The flasher, as well as the sunvalve, and the AGA porous mass were the inventions of the eminent Swedish scientist, Gustaf Dalen, for which he was awarded the Nobel Prize for Physics in 1912.

At frequent intervals during the period of the construction of the Panama Canal, the R. E. Dietz Company, of New York City, furnished the commission with lanterns. Those used most extensively on the Isthmus were the Dietz iron clad pattern. The main points of superiority in Dietz lanterns were their dependable burning qualities and excellent light. The special feature of the iron clad lantern which caused it to be selected by the Canal Commission was the heavy iron base, which not only protects the oil pot, but prevents the lantern from being easily blown over by high winds. No other lantern is fitted with this attachment.

Considering that the cost of a single lantern is small, some idea of the number used on the Isthmus may be obtained from the statement that the Dietz Company furnished more than $13,000 worth of its lanterns to the commission.

In connection with lights on the canal, the Macbeth-Evans Company, of New York and Pittsburgh, supplied large quantities of lantern globes, lenses, and railroad headlight chimneys. In this the Macbeth Pearl glass was specified. This firm supplies lenses to the light-house service, and the United States Navy, and headlight chimneys to the United States Army.

Special Devices at the Canal

That nothing should be left to chance which could be prevented by proper precaution, the commissioners, early in 1906, determined to have installed and put in operation a complete automatic electric fire alarm system for the protection of property in the Canal Zone. The automatic fire alarm and telegraph system manufactured by the Gamewell Fire Alarm Telegraph Company, of New York City, was decided upon, and a contract made with that company to install a complete system at Cristobal, Ancon, Empire, Gorgona, and Gatun, the contract price for the whole work being $20,264.35; but additions and extensions decided on later added $2,400 to the cost.

The Cristobal system was installed in 1906, and during the next year those in Ancon, Empire, Gorgona, and Culebra were placed in working condition. The Gatun system was not installed until 1909. The work of installation was done by the government engineers, under instructions from the Gamewell Company, that company supplying the apparatus and all material. The completed system practically covers the entire Canal Zone, with a large number of street signal stations, and a





1. Steel bins and shelving used throughout storehouses, government buildings, Canal Zone.
2. Aisle between two assemblies of steel bins and shelf installation at Balboa storehouses. (Furnished by Berger Manufacturing Co., Canton, O.)

number of auxiliary substations placed in buildings at some distance from the street signaling boxes. By these auxiliary stations all of the government buildings in the Zone are in direct connection with the whole fire department system, thus avoiding delay and loss of time in going to the street signal stations when fire is discovered in a building.

The contract was awarded the Gamewell Company on the acknowledged superiority of its system in other important government properties, and in more than 1,200 municipalities in all parts of the world. Fire alarm stations, being placed on streets and exposed to all variations of temperature, in order to be reliable at all times must be constructed and adjusted with such exactness as to resist all atmospheric changes. The apparatus manufactured by the Gamewell Company was especially adapted to meet the conditions prevailing on the Isthmus.

The signaling boxes used on the Zone are of the positive-non-interfering-successive type, which represents the highest development in fire alarm telegraphy. Boxes of this type are designed to prevent any confusion arising from alarms being sounded from more than one signal station at about the same time. They are so constructed that should two or more boxes be operated at or about the same instant, one box will be automatically selected to transmit its complete signal, after which the other boxes that were operated simultaneously will each, in turn, take the line, one after the other, and transmit its complete signal. By the use of these boxes the fire department is never misled or confused by a mingling of signals.

The gongs used in the systems on the Zone are of the largest size and are combined with visual indicators, thus giving the department the signal by both eye and ear. So complete are the arrangements that all possibility of mistakes in signalling is practically eliminated. Connected with the systems are automatic registers. Permanent records of all signals received at fire department houses are of great importance. The registering machines used in the houses on the Zone register the location number of the box sending the signal, together with the date and the exact time of receiving the signal. The registers are made of composition bronze and steel.

In addition to the non-interfering-successive signal boxes and the visual indicators, which minimize the chances for mistakes in transmitting and receiving signals, a repeating device is used. These repeaters are so designed that all circuits are operative from any of the box circuits, and they are equipped with positive non-interfering devices which prevent any interference between circuits. The repeaters are so arranged that should a break occur in any circuit the instrument after transmitting the signal on all the alarm apparatus in the system, will automatically lock out the disabled circuit, leaving the rest of the system intact; and when repairs are made in the disabled circuit the repeater will automatically take it again into service.

The American watchman's time detector, or as it is now called, the Morse magneto watchman's clock, supplied an important link in the vigilant watch kept on the Canal Zone during the construction period, and now has a permanent place in the administrative equipment. The clock apparatus is designed to keep a record of the various night watchmen assigned to the buildings and property along the canal and was furnished by the American Watchman Time Detector Company of New York.

During the construction period the clock itself in each place was located in the superintendent's office, and wires were run from this clock to the several stations where it was desired that the watchman should go; and as he operated each station in turn, it registered his time on the clock in the office, so that a permanent record was made of his doings. This covered the records of as many watchmen as were employed in that zone of operation.

The station instrument is simply a magneto generator, similar to the ringer

which was formerly in common use on the telephone system. The watchman merely turns the crank in the box at the station and this independently operates the clock in the office, without the use of battery or other electrical current, so that each station is entirely independent of every other station.

While the original installation was partly temporary, there is a constant demand for the clocks on the permanent buildings, and many are in use. The device conforms to the present requirements of the National Board of Fire Underwriters throughout the United States, and is the same apparatus that is in use in the great industrial and other establishments in this country and Europe.

The fundamental requirements of permanence that characterized the equipment throughout the Canal Zone is strikingly apparent in the steel office and filing devices used in the offices of the Canal Commission. The long task meant a vast accumulation of documents of all kinds, and the filing system which made them instantly available for reference was worked out with the usual thoroughness of the canal work.

Much of this equipment, made chiefly of steel, was built by the Art Metal Construction Company, of Jamestown, N. Y., the largest maker of steel office furniture in the United States. Among the devices installed by it for the use of the commission were 160 four-drawer vertical letter file cabinets, with a capacity for more than 320,000 letters; a number of flat and roll top steel desks, map cases, document file cases, and a large number of built-to-order filing cabinets. It also supplied steel dining room tables, sideboards, chiffoniers, dressers, and other furniture, such as are supplied by this company to United States battleships.

Before contracts were ordered for this class of equipment, a careful investigation was made into the merits of steel furniture. The conclusion was reached that no other fixtures were so impervious to moisture, dust, microbes and vermin, and that none were so readily kept clean. Durability, convenience, attractiveness of appearance, and economy of space were also factors in the selection of this equipment.

The steel filing cases were found to possess special merits, the weather having no influence upon the perfect working of the drawers. At a very early date in the work on the canal the unsuitability of wooden office furniture became apparent. In tropical climates wooden furniture is subject to the ravages of moths, the insects eating away the wood on the inside, leaving only an outward shell. Wooden furniture was found to need constant replacing because of the destructive insects, and because of the tendency of the weather to warp the wood. The use of steel equipment was found economical, and the filing cabinets were especially valuable because they furnished protection against fire for the important canal records. The steel filing cabinets were of double-wall, fire-resisting construction.

In the construction of its steel office furniture, the Art Metal Construction Company used fine plates of open hearth steel specially rolled for their product, the plates being very smooth, without scale, and free from buckle. The workmanship throughout was of the highest character, the finishes being wear-proof and dust-proof, with several coats of the best enamel.

The acme of efficiency reached in the details of canal construction insured the appearance in the administration offices of automatic time stamps to keep time records of all kinds. These were furnished by the Automatic Time Stamp Company, of Boston, Mass., originators of the "art of printing time." This useful device, so familiar at home in offices where efficiency is the watchword, was used wherever a time record was indispensable, and as many time records of all kinds were checked up at the canal, the little device played its part in the canal work.

Where so many large steam shovels, dredges, dipper buckets, locomotives and other expensive pieces of machinery were engaged in such arduous work and running to full capacity there was considerable breakage of important machine parts, such

as locomotive frames, crank shafts, steam shovel arms, dredge pump casings, etc. Here the Goldschmidt Thermit Company of New York figured in an important capacity as having the only process permitting the welding of these heavy sections without removing them from their position. In the case of locomotive frames, these were welded without removing the frames from the engines and without keeping the locomotive out of service longer than 12 to 24 hours. In one instance, a two-throw crank shaft was broken through the crank web and about half way around the crank pin. This was welded without removing it from the machine, which was only out of commission 15 hours.

The Thermit used for this work is a mixture of finely divided aluminum and iron oxide. This mixture can be ignited by means of a special ignition powder supplied by the Goldschmidt Thermit Company, and a chemical reaction ensues. The aluminum burns, and in so doing, takes away the oxygen from the iron oxide, becoming aluminum oxide, while the iron is set free and is precipitated as liquid steel in a highly superheated condition. The temperature of this steel is approximately 5,000 degrees F. and the time of the reaction is only 35 to 40 seconds. In practice the welds are made by pouring this steel into a mold surrounding the ends of the sections to be welded together, and which have previously been brought to a red heat by means of a gasoline compressed air preheater. The superheated liquid steel melts the ends of the sections with which it comes in contact, and amalgamates with them to form a single homogeneous mass when cool. The process permits of welding the heavy sections at practically any point desired. The welding was executed entirely by the mechanical forces at the canal, the Goldschmidt Thermit Company supplying the necessary materials and appliances and furnishing the necessary instructions. From 1906 to the end of 1914, over 86,000 lbs. of Thermit were shipped to the canal.

The Thermit Process still continues its good work and is being used for repairing the dredges and other machinery required for operating the canal and keeping it in proper condition.

The Standard Underground Cable Company, of Pittsburgh, supplied for the electrification of the Panama Canal rubber insulated lead-covered cable, varnished cloth insulated lead-covered cable, magnet wire, fixture wire, weatherproof wire, and cable terminals for outdoor and indoor service.

All the terminals used in the canal electrification were made by the Standard Company or by licensees under this company's patents.

A cable terminal is a device placed over the end of a lead-covered cable to protect the insulation from moisture or from electrostatic discharges between conductors, or from conductors to ground. One of the distinctive features which characterize Standard open air cable terminals (known to the trade as D. O. A. Terminals), is the method of joining the conducting stem, which acts as a continuation of the underground cable conductor, to the terminal insulator. Since this stem projects through the insulator, the joint between the two is a vulnerable point for the entrance of moisture in the form of rain or fog. The joint is made by means of a hooded flange on the stem which fits over the top of the insulator, the joint being rendered water-proof by means of a rubber gasket fitted inside the flange, and upon which the stem is tightly screwed down when the terminal is assembled. This moisture-proof joint between the stem and cable terminal is a distinctive feature of all D. O. A. terminals. The terminals supplied for the Canal have special features to adapt them for certain conditions on the Isthmus, but as to their protective features they do not differ from stock terminals supplied to other purchasers.

In connection with the improvements on the Panama Railroad the Morden Frog and Crossing Works, of Chicago, sent numerous shipments of its railway ap-

pliances. This included split switches, rigid frogs, switch stands, guard rail braces, derails, compromise angle bars, etc. They were manufactured at the company's Chicago Heights factory, under the direction of skilled engineers and labor, and with the highest type of machinery, and were the best equipment of their kind at the lowest price. The company's shipments continued from the beginning of the improvements on the Panama Railroad until the completion of the canal, its appliances being used in the many tracks which were laid in connection with canal construction.

The construction of the dam at Gatun and the consequent flooding of hitherto dry territory resulted in the submergence of the original right of way of the Panama Railroad for a considerable part of its length and made it necessary to relocate the line at a higher level. The new line was built in the most thorough manner possible, with ties of the best quality to withstand the severe climatic conditions, using large tie plates, screw spikes, etc. The highest refinement was considered economy in this work.

As a large number of the ties used were of guiacum or lignum vitæ, and other very hard tropical woods, it was necessary to prepare the ties by adzing them to plane surfaces where the tie plates would rest, and to bore them for the spikes, as no spike of any pattern could be driven directly into these dense woods.

An ingenious automatic machine for performing these adzing and boring operations simultaneously was supplied by Greenlee Bros. & Co., of Chicago, and Rockford, Ill.

Greenlee Bros. & Company had also a number of interesting machines in the shops at Gorgona for framing the heavy timbers used in car construction, and in keeping in repair the steam shovels, dredges, etc., used in the excavation work. Among these were a large automatic timber groining machine and a heavy end tenoner for cutting tenons on the ends of timbers up to twenty inches square. On these machines the work is done from six to ten times as fast as it could be done by hand, and much more accurately. As time was the important factor in all work pertaining to the construction of the canal, these machines repaid their cost many times following their installation in 1908.

Various details of construction plans, as well as climatic conditions, called for the extensive use of wood screws in the work at the canal. The wood screws manufactured by the American Screw Company, of Providence, R. I., were furnished in large quantities, either direct from the point of manufacture or by outside firms handling their goods.

Samuel M. Nicholson, who is president of the American Screw Company, is also president and general manager of the Nicholson File Company, of Providence, which filled numerous orders and contracts for the supply of files to the Canal Commission from the beginning of construction on the Isthmus.

In the list of concerns furnishing the canal authorities with special efficiency devices was the Belding & Franklin Machine Company, of New York, which furnished for the commissary department a number of machines for peeling vegetables. These machines were selected for their economy and speed, and were found to be durable and efficient.

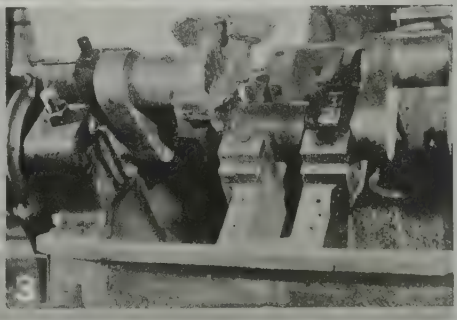
Administrative Supplies

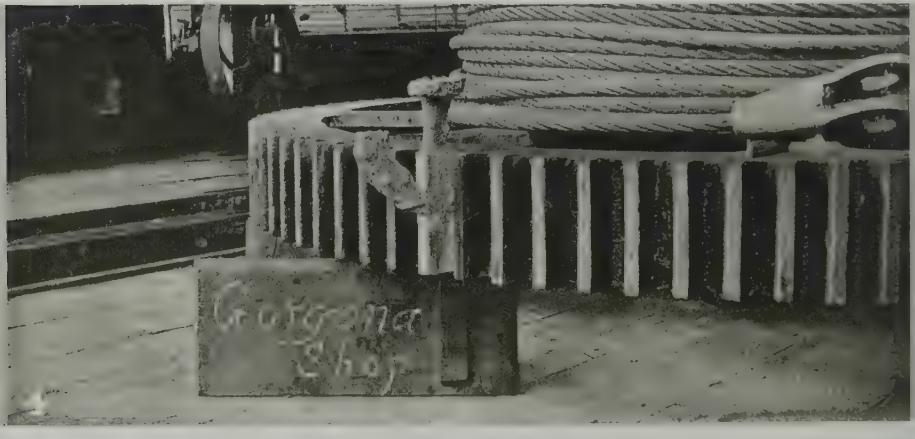
No single work ever undertaken by man called into play so many machines of different kinds, and for different purposes, as the building of the Panama Canal. The natural first thought of the layman would be to ask as to what possible part of the great work a typesetting or typecasting machine could apply.

The commissioners early determined that the public should be thoroughly and correctly informed of the progress of the work. They believed, as the canal was to be the property of the people, the people should be given an opportunity to know just how the work was being done, and









1. Welding dredge pump casing in place, by Goldschmidt Thermit Process.
2. Stephens-Adamson steel pan conveyors.
3. Crank shaft welded by Goldschmidt Thermit Process.
4. Sample of breaks repaired by Goldschmidt Thermit Co., New York.





1. Locomotive crane at work on the canal.
(Supplied by the Browning Engineering Company, Cleveland, Ohio.)
2. Ten-ton refuse destructor at Culebra, Canal Zone.
(The Morse-Boulger Destructor Co., New York.)

know it from official sources, so a record of every event was kept and made public.

In this rapid age the old method of setting type by hand is almost a tradition. It was too slow a method to keep abreast of the times, and new inventions were called into play, among them being machines to compose type and cast type. The only machine of this kind is the one known as the Monotype. It is a modern creation, and has rapidly developed from its original form and capacity until it is now in fact a paragon of usefulness.

Nine years ago the capacity of the machine was limited to the casting and composing of type in four sizes only, the sizes most in use in newspaper work. The range has been extended until today it casts type of thirty sizes, and as a composing machine its range has increased until it reaches to what is known in printing offices as eighteen-point. At the same time the measure or width of the line has been extended from seven to fourteen inches.

It is difficult to give in a brief space a description of a Monotype which the layman can readily understand, but some points can be made clear to his mind, giving him an idea of the great advance made in printing by the introduction of machines for casting type.

The Monotype machine, or rather the Monotype system, is in two parts—the keyboard and the caster. This separation of the keyboard, or operating mechanism, and the caster, or casting mechanism, has resulted in a very high degree of composing-room efficiency, because the operator working on copy is undisturbed and has no more to think of than a stenographer operating a typewriter; and, similarly, the casting machine, which is wholly automatic, takes no account of the style or punctuation, and doesn't have to wait for copy. On account of this division of the work of a composing machine the Monotype is known among printers as a machine of continuous production, because one part of the Monotype mechanism is always busy.

The keyboard mechanism perforates a ribbon of paper, which, in turn, controls the movement of the caster. This perforated ribbon looks very much like the music rolls of a pianola. The perforations are made by punches controlled by the finger keys, arranged in identically the same letter-arrangement as that of the standard typewriter. There are two hundred and forty-seven keys. They correspond to all the characters used in the several faces of type intended to perform the work in hand, with thirty additional keys which control the justifying mechanism; that is, the device which accurately equalizes the space between the words, so that all the lines within one measure may be of the same length.

When the paper ribbon is fed into the casting machine, currents of compressed air pass through the perforations. These set the mold blade to the right size for the character to be cast, and cause the matrix to be properly positioned. Metal is pumped from a metal pot below, and when cast the type is placed in its proper position in the line, and when a line is finished it is automatically removed.

A great national undertaking, such as the construction of the Panama Canal, necessarily requires an amount of printing that could not be readily handled without a composing machine and a typecaster. The Monotype was selected by the commission because it was believed to be the best adapted to meet the exacting requirements of the work it would be called upon to perform.

The capacity of this machine may be best understood by the statement that the Encyclopædia Britannica, the largest job of type composition ever placed in the United States, consisting of some thirty thousand pages, was cast and composed by the Monotype, as was the Standard dictionary, a work requiring a great variety of special characters.

In connection with the office work of the administrative staff at Panama, the T. S. Buck Manufacturing Company, of New York, entered into contracts for supplying changeable rubber type outfits and holders.

These outfits are made from printers' metal type, which is pressed into a matrix or mold, consisting of plaster, talc, dextrine, and other compositions. The mold is dried on a steam table, and when it is dry a sheet of raw rubber is forced into it with a vulcanizer and held until cured; then the letters are cut apart and boxed. With the outfit is included a patent flexible cushion, so that a perfect impression can be made on any surface, rough, uneven, concave, or convex, as well as flat.

In every great undertaking two factors and two problems are present—the physical and the clerical. The modern business world is an illustration of this fact. Its physical activities, in all their magnitude, presuppose clerical activities of corresponding magnitude. Everything that is done must be conditioned by the means at hand to record what is done.

The modern world owes a real debt to the writing machine; a debt which it owes in particular to the Remington, the pioneer of the industry. The typewriter facilitates labor, by enabling one person to accomplish more in the same number of hours than under the system prevailing before typewriters were invented. The tremendous volume of modern business could not be carried on without the aid of this invention. This is the age of vast enterprises, and its business activities can be carried on only through the means of clerical labor of great magnitude. It is the writing machine that makes this clerical labor possible.

The building of the Panama Canal was the greatest of modern undertakings, involving not alone problems of physical labor, but problems of clerical work. It being an undertaking by the government and not by private enterprise, the clerical work was greatly increased from the necessity of making many and extended reports to the government departments and to Congress, which would not be required from a private enterprise. It takes but a moment of thought to convince one that without the aid of the typewriter the immense amount of clerical work required in the building of the canal could not have been performed satisfactorily, if at all. In other enterprises of great magnitude, such as the construction of the Suez Canal, or the building of St. Peter's, at Rome, the work was extended over a long series of years, that of St. Peter's passing the century mark. Such enterprises, spread over such a length of time, required comparatively little clerical labor, but the building of the Panama Canal was crowded into a few years. Hence the speed with which the work was done added immensely to the clerical labor required. Thus the Remington typewriter is to be classed among those inventions of modern times which enabled the government to construct this great waterway in record time.

Remington typewriters were used in connection with the work of building the Panama Canal from the very beginning, when the government took hold of the enterprise. They were used in Washington in the preliminary clerical work of correspondence in connection with the original purchase, and since then with the clerical work in all its branches, and at all principal points in the Canal Zone, and in nearly every department of the work, as well as in the offices of the firms and manufacturing companies engaged in supplying machinery and materials for the construction work.

Conditions of work in the Canal Zone were very trying on all mechanical devices, not only because of the exacting work demanded, but because of the climate. That the Remington typewriter successfully met all these conditions is established by the fact that several machines sent to the Zone when the government began the work are still there, and still rendering the same efficient service as when first purchased.

The immensity of the correspondence and copying of papers and specifications for contracts made necessary in carrying on the work of building the canal is evidenced by the fact that the Underwood Typewriter Company sold to the commission 650 of its mechanical writing machines,

for use on the Canal Zone, in addition to the very large number in the offices in Washington. All the machines sent to the Canal Zone were of bronze, as such machines were much better adapted to the climatic conditions prevailing on the Isthmus, being entirely rust proof.

The machines were used for correspondence, for the preparation of data, contracts, etc., and for filling in blank forms of all widths and descriptions. That there might be no delays, no mistakes, no duplications of any part of the huge undertaking, daily reports were made from all, even the most insignificant branches of the work, and these reports were required to be copied for the information, not alone of those directly in charge of the whole undertaking but those in charge of each part of it. All this work of making the original reports and the copies was done by the use of mechanical writing machines. It could not have been done otherwise.

Every piece of mechanism used on the zone or in the construction of the canal had to be made with a view to meeting the climatic conditions. This fact added very largely to the labors of those having direction of the work, in seeing that all equipment met such requirements. The ordinary mechanical writing machines, or those made to meet the requirements of the temperate zone, or for use in a dry climate, would have soon failed on the Isthmus; hence the wisdom in purchasing those made of bronze. The Underwood, being constructed for work of varying widths, for preparing tables, filling in specifications, etc., met all requirements of the commission.

For handling accounting and other records in connection with the system of keeping track of the canal work, a number of standard writing-adding machines manufactured by the Elliott-Fisher Company, of Harrisburg, Pa., were furnished to the Canal Commission. The wide scope of work that could be advantageously handled on these machines, and their superior durability led to their selection. The machine is manufactured from parts produced from the finest grade of machinery and tools in the Elliott-Fisher factory, and the fact that the writing machine with the adding machine combined can be placed over any number of columns, permitted its use in many ways that made for economy and accuracy in keeping the canal accounts and records.

Enormous quantities of stationery of various descriptions were consumed at Panama. The bulk of this was furnished by the Tower Manufacturing and Novelty Company, of New York, and during the period of construction hardly a steamer left New York for Panama without carrying a consignment of stationery and miscellaneous office supplies from the company to the canal authorities. The company carried such a large and complete stock on hand that it was able at any time to meet the wants of the commission, and this was a factor in the continuous business awarded to the company.

A great American concern which figured indirectly in the canal work was the Interlaken Mills, of Providence, R. I., the largest manufacturer of book cloths in the United States. For many years this company has supplied nearly all the cloth for the government printing office at Washington, where, in addition to other publications, it was used in binding the *Canal Record*, the official publication of the Isthmian Canal Commission.

Cable and Telegraph Facilities

The officials at Panama Canal were kept in instant communication with the Washington government, and other points in the United States, through the extensively equipped cable and overland telegraph system of the Central and South American Telegraph Company. The lines of communication to Mexico and Central and South America available through this system are graphically shown in the accompanying plate.

J. H. Bunnell & Co. Inc., manufacturers, importers, and dealers in telegraph, telephone, railway, and electric lighting

supplies, with headquarters in New York, one of the oldest and best known electric houses in the world, had the distinction of furnishing the instruments and equipment in its line that were used to facilitate the construction work of the Panama Canal. This company has a reputation for manufacturing high grade apparatus, and its product met the high standards of efficiency called for on the Canal Zone.

Building Material and Equipment

In 1904 and 1905, in the early rush of the canal work, many portable houses were set up by the Canal Commission along the zone of construction. These buildings were supplied by the Ducker Company, of New York, the pioneer in this line of manufacture in the United States. The Ducker sectional portable house has been manufactured by the company for the past thirty years, and this long experience, combined with excellent manufacturing facilities, has brought about the production of a system of sectional portable construction that is acknowledged by the engineers and experts to have reached perfection.

Although these houses are erected without the use of nail or screw, they have all the attributes of the best permanent construction, while at the same time they are adapted to speedy demolition and quick reërection. There is nothing unusual in the appearance of these buildings, and in fact they are architecturally correct. They are turned out by machines, assuring mechanical accuracy of parts, perfect fit, and ready interchangeability. These sections are made at the Ducker factory in sections two feet and nine inches wide and any desired height, including windows and doors. The construction is patented, and was adopted by the United States government as a standard of excellence after a rigid inspection by the government engineers. The buildings erected at the canal were for offices and wireless telegraph houses. They are in general use for all kinds of government buildings, schools, churches, bungalows, railway stations, cottages, garages, and emergency buildings of various kinds.

In the evolution of the building methods at the Isthmus, following the beginning of the canal, from the primitive structures of Spanish-Indian character down to the latest types of finished and sanitary construction, such as are now to be found throughout the entire zone, the National Fire Proofing Company, of Pittsburgh, played no inconsiderable part.

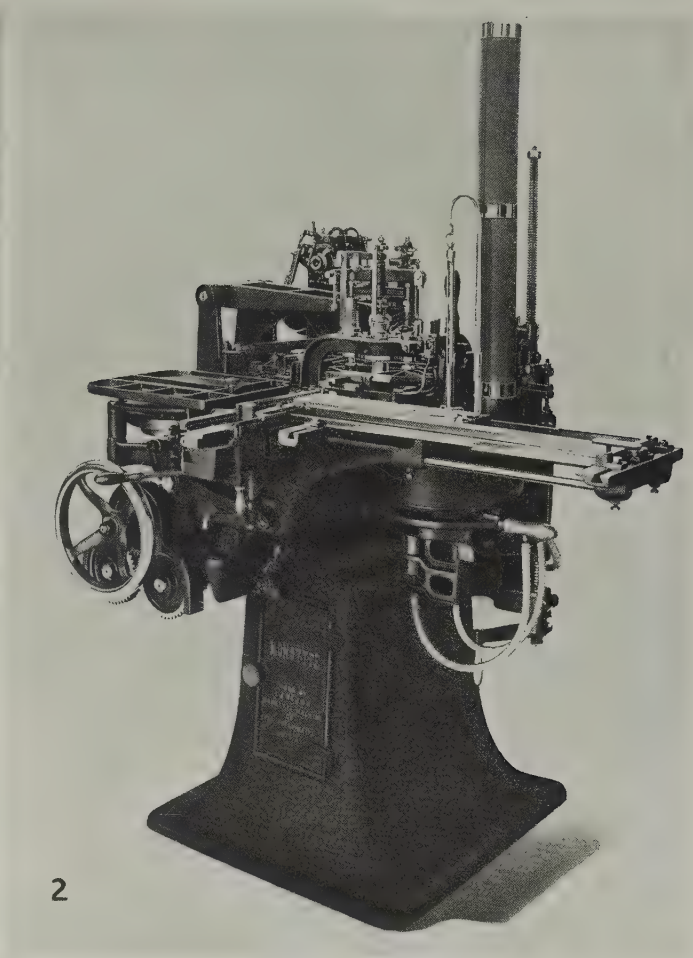
The main product of this company used in building construction at Panama was its "Natco" hollow tile, an article that had commended itself throughout the building world. At the time the National Fire Proofing Company was called upon by the Isthmian Canal Commission to furnish supplies no information was given regarding the buildings in which the tile was to be used. It was subsequently ascertained, however, that such mention was not necessary, as the tile was used in the construction of practically all prominent buildings erected in the Canal Zone. Foremost among these are the government cold storage plant, the administration building, the Washington hotel, and the new station for the Panama Railroad at Panama City, all of which are fireproof throughout.

The government cold storage plant, located in Colon, is one of the largest and most completely equipped plants in the world. The capacity of the plant is such that from it 50,000 people can be supplied daily with fresh foodstuffs. The extraordinary climatic conditions under which this plant is maintained, with the excessive tropical temperature and humidity the year round, necessitated its construction throughout with an absolute non-conductor of heat. Such a non-conductor was found in "Natco" tile, serving at the same time as fireproof protection for the vast amount of perishable products.

The administration building at Ancon is one of the most beautiful architectural structures on the Isthmus, and was designed as a permanent and practically indestructible home for the executive and

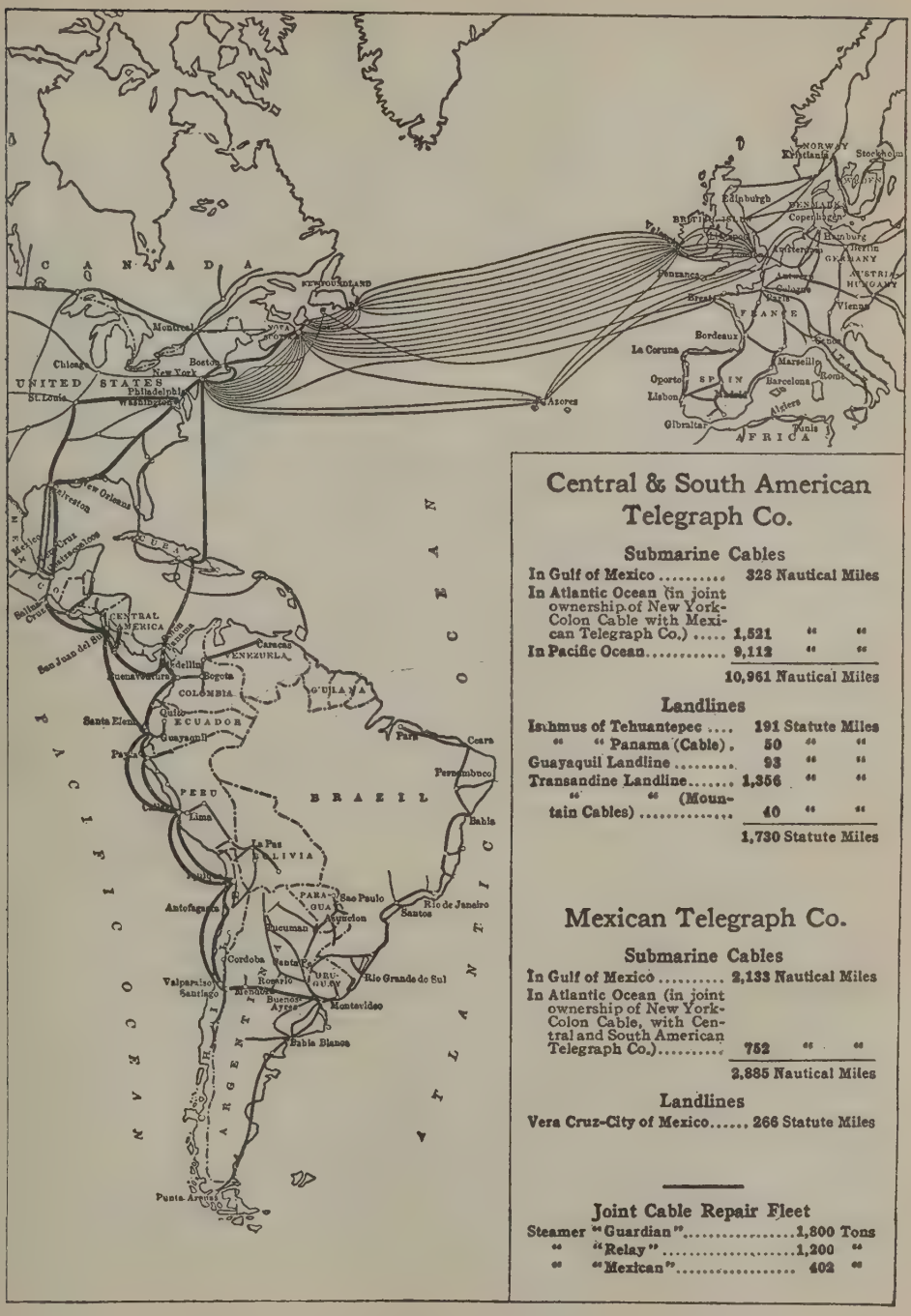


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1. Keyboard of the Lanston Monotype Machine used by the Canal Commission.
2. Lanston Monotype Casting Machine used on the Canal.
(Lanston Monotype Machine Company, Philadelphia, Pa.)



Central & South American Telegraph Co.

Submarine Cables

In Gulf of Mexico	328	Nautical	Miles
In Atlantic Ocean (in joint ownership of New York-Colon Cable with Mexican Telegraph Co.)	1,521	"	"
In Pacific Ocean.....	2,112	"	"
	10,961	Nautical	Miles

Landlines

Isthmus of Tehuantepec	191	Statute	Miles
" " Panama (Cable).	50	"	"
Guayaquil Landline	93	"	"
Transandine Landline.....	1,356	"	"
" " (Mountain Cables)	40	"	"
	1,730	Statute	Miles

Mexican Telegraph Co.

Submarine Cables

In Gulf of Mexico	2,133	Nautical	Miles
In Atlantic Ocean (in joint ownership of New York-Colon Cable, with Central and South American Telegraph Co.).....	752	"	"
	2,885	Nautical	Miles

Landlines

Vera Cruz-City of Mexico..... 266 Statute Miles

Joint Cable Repair Fleet

Steamer "Guardian".....	1,800	Tons
" "Relay".....	1,200	"
" "Mexican".....	402	"

Cable Connections with the Isthmus.

administrative affairs of the canal and the United States government.

The new Washington hotel's a three-story structure, the only wood being that used in door and window frames and the ball-room floor. All other floors are of Natco hollow tile, furnished by the National Fire Proofing Company, while the walls are of steel and reinforced concrete frame work, with hollow tile curtain walls. In the $85,000 station at Panama, hollow tile was utilized to the fullest extent, finding a place not only in wall construction but in the circular pillars and arches of a building of classic design.

With characteristic official policy, the representatives of the government refused to commit themselves on the subject of materials to be used in all the permanent buildings without making experiments with cement blocks, as in the fire department headquarters at Cristobal, and with reinforced concrete, each of which defeats the devouring ant, and offers resistance to the sun and fire, whatever may be said against their value in a climate of excessive dampness. But with all the materials of the United States to draw from, and with no restrictions beyond those imposed by conditions at the Isthmus, the government selected for its first permanent buildings, inside and out, terra cotta hollow tile. "Will hollow tile make good in the tropics?" was asked of the man on the ground representing the Central American Construction Company. "It's the ideal building material for this country," was his answer. "It's cooler than any other. It is impervious to moisture, which counts in a land where it rains nine months out of the year. The ants can't harm it, and it is proof against fire."

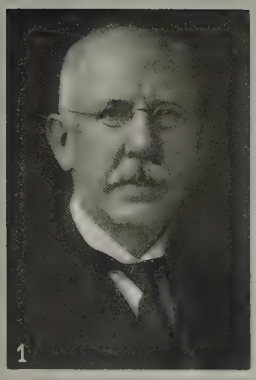
What is true of its use in the tropics is applicable, of course, to the conditions experienced in the temperate zone. The hollow tile block of the National Fire Proofing Company is the outcome of many years of experimenting. Its dead air space makes it warmer in winter and cooler in summer in houses or other buildings where it forms part of the construction work. Other advantages are its minimum weight, its sound proof qualities, its imperviousness to moisture, the possibilities of rapid construction where it is used, and the fact that it may be laid at any time of year, without reference to weather, temperature, rain, or snow.

Thousands of buildings in the United States have used hollow tile, including trust and bank buildings, apartment houses, art galleries, sky scrapers, bungalows, and costly private residences, as well as silos in the agricultural districts. It is also adapted for use in the construction of less pretentious residences, as it gives to them all the stability and strength that is to be found in the structural work of the sky-scraper order of architecture.

The National Fire Proofing Company was organized in 1889. It is engaged in the manufacture and installation of fire-proofing material of every description, hollow building blocks, conduits, sewer pipes, drain tile, and other forms of clay products. The raw material used is clay, which is mined from properties owned by the company in proximity to the markets, thus providing for the transportation of the finished ware with economy.

The factories of the company, twenty-six in all, have a total annual capacity of about 1,000,000 tons of finished product. The company has engineering, constructing, and draughting organizations in connection with its offices in Pittsburgh, New York, and Chicago, and maintains a completely equipped testing laboratory in Chicago. It has offices in several of the more important cities of the United States, from New England to the Pacific Coast.

With the introduction of modern building construction at the Isthmus, consequent upon the beginning of work at the canal and the housing of government employees, calls were made on manufacturers of all sorts of building material combining elements of ornament and attractiveness, as well as durability and protection. In this connection there was brought into the canal















TYPES OF AMERICAN BUSINESS MEN WHO CO-OPERATED ALONG VARIOUS LINES IN AMERICA'S GREAT WORK AT PANAMA

1. George E. Earnshaw, Pres., Earn Line S. S. Co., Phila., Pa.
2. S. W. Whitmore, Whitmore Mfg. Co., Cleveland, O.
3. L. E. Johnson, Pres., Norfolk & Western Ry.
4. John Kolb, Pres., Theobald & Oppenheimer Co., Phila., Pa.
5. Gustav Dalen, American Gasaccumulator Co., Phila., Pa.
6. Thos. E. Coale, Pres., T. E. Coale Lumber Co., Phila., Pa.
7. F. C. Austin, Pres., Municipal Engineering and Contracting Co., Chicago, Ill.

work the firm of David Lupton's Sons Company, of Philadelphia, which, in 1911, furnished to the Canal Commission 110 Lupton hollow metal windows for the government buildings at Colon.

These windows were glazed with wire glass, and were used to protect from fire the buildings in which they were installed. The material used was keystone metal, a copper-bearing open hearth steel, which offers a particularly successful resistance to corrosion and to the action of all gases and fumes.

The Lupton Company, which was one of the earliest manufacturers of this type of fireproof windows, has had over forty years' experience in roof lighting and metal windows. Among its specialties in construction are roof formations to aid in the quick removal of gases and fumes, as in foundries and laboratories; arrangement of roof levels in power houses for the conduct of heat; special adaptation of material and construction to the needs of forge shops, machine shops, and weave sheds, and the arrangement of sash panels and lighting and ventilating areas in multiple-story buildings. The Lupton Company furnishes and installs the latest developments in steel sash, steel partitions and doors, rolled steel sky-lights, hollow metal windows, louvers and operating devices for the effective control of all types of windows.

The main office and works of the David Lupton's Sons Company are at Allegheny Avenue and Tulip Street, Philadelphia, Pa. The works are given over exclusively to the special construction of material for light and ventilation in fireproof buildings. The company also has offices in New York, Pittsburgh, and Chicago. Its leading officers are: Edward Lupton, president; David D. Lupton, treasurer; and E. T. Wilkinson, secretary.

The prominent part played by the Thomas E. Coale Lumber Company in construction work at the canal is shown by its record of lumber shipments, which in two years reached nearly 4,000,000 feet of lumber and piling, with nearly half a million feet of orders for lumber to be filled.

It was not until the latter part of 1911 that the company entered into business relations with the Canal Commission. At that time its New Orleans agent took the first order for a quick shipment from that port. This was followed by large bids for piling and lumber, resulting in many awards, all of which were filled promptly and some under unusual conditions calling for the highest order of business enterprise. One instance of this character was of especial interest. At the height of the task of filling its contracts, the failure of one of its sub-contractors left the company without the supply of piling necessary to fill its order. Realizing its responsibility to the government, the company at once chartered a steamer at Gulfport, at a freight rate of $250 a day, before it had secured a single foot of lumber to go on the boat. It then took up the business which its sub-contractor had failed to handle successfully, and within ten days the boat was loaded and on its way to the Isthmus.

Thus began the relations of the Thomas E. Coale Lumber Company with the canal. It first utilized the steamers of the United Fruit Company in transporting its materials. Later the company chartered the *Haakon VII* and the *Thelma* through its Jacksonville agent, and after August, 1912, kept those vessels in constant commission carrying lumber and piling from the Atlantic coast to Colon.

In the construction work large quantities of heavy timbers were used, practically all shipped to the Canal Zone from the United States. The heavy timbers were mainly used as dipper handles and spuds for dredges, and were chiefly of Douglas spruce shipped from Seattle and Tacoma, Wash. Four of these timbers were twenty-four by twenty-four inches and sixty-five feet long. Four other pieces of the same length were twenty-eight inches in diameter, dressed round. Firm white oak and yellow pine were used in the construction of the spill-

ways, repairs of cars, and for car stakes. The oak and pine were shipped from Baltimore. George R. Johnson, of Baltimore, was the contracting party for furnishing much of the lumber and heavy timber used.

J. K. Joice, of Chicago, had the distinction of receiving the Canal Commission's first order for lumber, and he continued with additional shipments from time to time, his total consignments running in value to about $750,000. The lumber supplied was used throughout the Canal Zone in various ways, much of it going into buildings, and the remainder being used in the construction of the canal works.

The D. L. Gillespie Company, of Pittsburgh, a large firm widely known throughout the country, was prominent in the canal work through shipments of lumber and building material in great quantities.

Early in the history of canal operations the Gold Metal Camp Furniture Manufacturing Company, of Racine, Wis., received orders from the Isthmian officials for supplies of its Gold Medal camp cots for the use of the employees at the canal. In all between 30,000 and 40,000 cots manufactured by this company were ordered. Of this number nearly 15,000 were contracted for by direct order, and thousands more were supplied through dealers at Panama. The orders filled from the Racine headquarters aggregated $38,000 in total cost.

The Gold Medal Camp Furniture Manufacturing Company received its orders as the result of competitive bidding. Its bids were not only the lowest for the quality of cots called for, but the cots were recognized as best adapted to use in tropical climates, being constructed of wood, steel and canvas, in accordance with the United States army specifications. The company's highly developed manufacturing plant also gave it exceptional facilities for the immediate filling of large orders. The cots were mainly used as beds for laborers, and in the hospital wards. In addition to the direct shipments and those supplied through local dealers, it is understood that the War Department furnished many more cots from its stock of these goods, of which it usually has a large quantity on hand.

The high estimate in which these cots are held is attested to by their general use in the government departments. Immediately after the close of the Spanish-American war the War Department advertised for 67,000 cots, and after thoroughly testing the different kinds offered, of which there were more than twenty samples submitted, the product of this company was selected as the best suited for war purposes, and especially for service in the insular possessions of the United States, as well as for the soldiers then still stationed in Cuba. The Medical Department of the United States army and also of the navy have adopted this cot as their standard.

Some of the stools, chairs, and portable bath tubs of this company have likewise been adapted as standards in the army and navy, to which large quantities have been furnished from time to time. Another product of the Racine concern which has been purchased in large numbers by both the army and navy is the United States army standard litter. These are also manufactured for various railroads and other corporations throughout the United States. The company's products are found in every civilized country.

For a number of the permanent government shop and other buildings on the Canal Zone, as well as for several of the temporary buildings, rolling shutter doors, manufactured by the Jas. G. Wilson Company of New York were furnished from the company's factories at Norfolk, Va.

These doors were of the interlocking slat type, made of No. 20 gauge steel, galvanized and operated by electric motors. They were equipped with the Wilson Company's patent anchor device to prevent their being blown out of the grooves in high winds.

Thirty-nine of the Wilson shutters were installed in the permanent shop buildings at Balboa, and at Panama thirty-nine doors were furnished for the Panama Rail-

road freight house. In addition, the Wilson doors were used in the temporary forge, boiler, and erecting shops at Balboa during the canal construction period.

John Lucas & Company, of Philadelphia, with factories at Gibbsboro, N. J., and Chicago, and branch offices in all the large cities of the United States, furnished great quantities of paint and varnishes for the buildings and machinery at the canal. Under the trying climatic conditions on the Isthmus, this paint and varnish was found completely up to standard.

The oldest mercantile house in America is that of F. W. Devoe & C. T. Raynolds Company, manufacturer of paints, varnishes and painters' supplies, of New York. This house was founded in 1754, when George II reigned over England, and ruled America. Not only is it the oldest mercantile house in the United States, but it is the largest concern in the world devoted to the manufacture of paints, varnishes, brushes, and artist's materials.

It was originally founded by William Post, and has continued in an unbroken line of succession for 160 years. The watchword with which William Post began business in a little way in 1754, was "high quality of product," and that has continued to be the watchword of his various successors, and is still on their banner. The name "Devoe" on a package, can, or brush, is its guarantee as to quality of material used, and of the workmanship in producing it.

The trade of this firm reaches every part of the continent. It operates offices and salesrooms in every large city of the country, and has factories in New York, Chicago, Brooklyn, and Newark, N. J. The firm was an important factor in furnishing supplies for the construction for the great waterway connecting the two oceans. The climate of the Isthmus renders almost everything subject to rapid decay, especially iron and steel, and the best protection is afforded by paints and varnishes. These necessary articles were supplied in large quantities and from one end of the canal to the other Devoe's paint is seen.

The word "hammock" is derived from the hamack tree of Brazil, the fibrous rind of which has been used by the natives for centuries for the manufacture of *hamacas* or nets in which they sleep.

The German word "Hang-matte," meaning hanging mat, has been supposed by some persons to be the origin of the word, but it seems certain that the hammock itself is of American origin.

Columbus, in his account of the earliest voyage to America, speaks of the Indians coming down to the sea to barter their cotton and *hamacas*, or sleeping nets, for the baubles the mariners offered.

In tropic climes, with the long rainy season, the necessity becomes apparent for some cool, elevated sleeping arrangement which places the sleeper out of reach of pests and reptiles. The natives of "Brasill," as it was then termed, must have led in the early manufacture of hammocks, and the name "Brasill beds" has been given to the hammocks of their making.

Down through the years since the discovery of America we find the hammock, with its "soothing seductiveness," referred to in song and story, until today the *hamaca* or sleeping net of the aborigine has, by various stages, been developed to the perfection found in the product used by the canal army, which was furnished by the Hohlfeld Manufacturing Company, of Philadelphia.

It is the natural sequence of the development of American lines of industry from ideas furnished by the aborigines to find that surprising numbers of Hohlfeld hammocks were used on the Isthmus. The hammocks furnished by this company, if placed end to end, would reach a distance of about four miles. In the varied assortment of this company can be found hammocks for the poorest native of even the countries in which the hammock originated, as well as couch hammocks or hanging divans fit to grace the arbor of a prince. Hammocks for the dweller in the country where out-door space is abundant, folding hammocks for the city dweller, where space is limited, collapsible couch hammocks for

the camping or prospecting party, or for the sailor, are all manufactured by this company.

The Ludowici-Celadon Company, of Chicago, manufacturers of terra-cotta roofing tiles, entered into several contracts with the Canal Commission for promenade tile, cove-base, and angles for the floors of the Colon hotel. The material included in three contracts shipped in 1912 comprised 101,000 square feet of six by nine promenade tile, 10,650 feet of cove-base tile, and 3,900 feet of cove angles. These were a vitreous shale tile adaptable to any climate, and could be used either for floors, or flat roofing. This particular shipment of tiles was manufactured at New Lexington. This is one of the Ludowici-Celadon Company's factories, three others being located at Coffeyville, Kan., Chicago Heights, Ill., and Ludowici, Ga. In addition to the floor tile supplied to the hotel at Colon, the company shipped large quantities of roofing tiles for use on the Isthmus. These were found well adapted to the tropical climatic conditions of Panama, and gave general satisfaction.

In keeping with the rest of the canal's equipment, the glass which entered into the construction of the buildings at the canal was manufactured in the United States. Swindell Brothers, of Baltimore, manufacturers of druggists', chemists' and perfumers' glassware and window glass of all kinds, were heavy shippers of window glass to the canal, their shipments in the period between April, 1910, and July, 1912, running to 40,000 square feet of the best quality, double thickness window glass and 700 square feet of rolled glass. Superior quality, reasonable price, and prompt delivery secured the business for this company.

Practically all the fire brick for the power plants on the Isthmus was furnished by the Chas. Taylor Sons Company, of Cincinnati. The commission specifications for this article were the severest ever exacted, and the company maintained a continuous laboratory check on the product as it came from the factory, thus fully keeping up with the specifications.

The Hydrex Felt and Engine Company, of New York, specialists in structural water-proofing, and manufacturers of Hydrex waterproof felt, Pluvinox reinforced roofings, Saniflor deadening felt, Novento building paper, waterproofed papers and burlaps, compounds, asphalts, paints, etc., furnished large quantities of their product for the buildings on the Canal Zone.

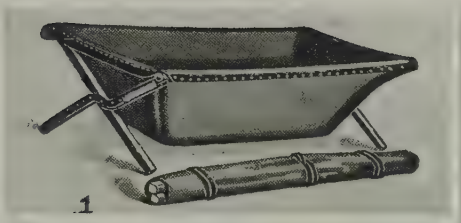
In all the administrative buildings and homes on the Isthmus, special attention was given to lounge and chair equipment as an offset to the enervating climate. In supplying chairs and lounges, which added greatly to the comfort of the canal workers and their families, the firm of Thonet Bros., of New York, was prominent.

The Panama Canal was above all a utilitarian project, but one American firm is distinguished by having furnished material for the beautification of the Canal Zone. This was Peter Henderson & Co., of New York, who over a series of several years furnished the canal authorities with quantities of flower seeds. The firm also supplied vegetable seeds, and many varieties of flowers and vegetables from these flourished on the Isthmus, giving an added interest to the homes of the canal workers.

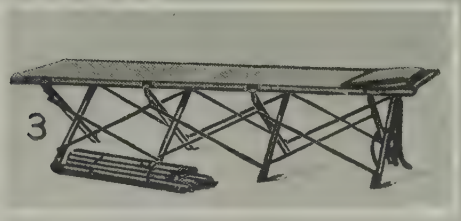
Marine Equipment

During the construction period a number of vessels needed for the Pacific side of the work gave a practical demonstration of the need of the completed canal by having to travel around South America in order to reach their place of work. One of these was the tug *Cocoli*, formerly the tug *Catherine Moran*, built for the Moran Towing and Transportation Company, of New York, in 1904, and sold by that company to the Isthmian Canal Commission in 1907.

The *Cocoli* is constructed of steel, with steel deck house, and has a length of 105 feet, and beam of twenty-three feet. She was fitted out for the trip to La Boca, on













1, 2, 3 and 4. Canal living equipment supplied by the Gold Medal Camp Furniture Manufacturing Company, Racine, Wis.
5. Portable wireless station building at Colon.
6. Portable cottages for the canal engineers.
(Portable buildings supplied by the Ducker Company, New York.)

the Pacific side of the Isthmus, at the pier of the Panama Steamship Company in New York, and on October 25th, 1907, left New York in charge of Captain Phillips, and Chief Engineer John Sperr, both of whom were employed by the Moran Company on the tug before she was sold to the commission. Passing through the Straits of Magellan during the middle of December, the *Cocoli* reached La Boca on January 9th, 1908. Her trip was very successful, as she made no stops other than those necessary to secure supplies, and arrived ready for duty.

The manufacturing center of Buffalo, N. Y., which had such a large part in supplying equipment for the canal work, scored again through the Buffalo Gasoline Motor Company, which supplied gasoline marine engines for the canal motor boats *Manzanillo*, *San Blas*, *Toro Point*, and others. The company also supplied a number of seven and one-half, ten, and fifteen horsepower gasoline engines for use at various points on the canal.

Two floating hoists, the largest ever constructed, were built for the Canal Commission by Neumeyer & Dimond, of New York, manufacturers of all kinds of cranes, loading and conveying plants, and shipyard, mining, milling and other equipment.

The Canal and the Camera

There are interesting features about the canal other than the great work of construction. Among these may be classed the story of the building of the canal as told by photography. The canal is the first great engineering enterprise occurring in the history of the kodak, or, it might be said, in the history of amateur photography. The complete photographic records of the canal construction suggest the part the kodak is destined to play in the future in recording historical events.

The story of the building of the great Egyptian pyramids is buried deep in the sands of the desert, and the world has not even a tradition as to when, how, and under what sacrifices they were erected. The story of the building of the Panama Canal is pictured in millions of permanent films, and will be carried to succeeding generations.

From the moment it was announced to the world that the United States had acquired sovereignty over a strip of territory running from ocean to ocean, and through that narrow strip would dig a canal connecting the waters of the Atlantic and Pacific, the Canal Zone became a favorite field for amateur photographers. Kodaks were to be seen everywhere. Camera-armed tourists went to the Isthmus in troops, snapping every foot of the great ditch from Panama to Colon. Officially and unofficially they covered every detail of the work, from the steam shovels which scooped up earth and stone by the ton, to the little donkey engines that hauled the dirt to the dumping grounds. Every incident connected with the work is somewhere on photographic records.

Through the work of the kodakers the public in this country and in Europe was able to trace from day to day every step in the work of building the canal. Through them the Gatun dam and Culebra Cut are as familiar to the public as are the Capitol at Washington or Niagara Falls. These pictures have also brought to the comprehension of the public the difficult and complex engineering problems connected with the work. In addition to their immediate educational value they have furnished a valuable historical record.

Picture taking on the scale followed at Panama, and under the conditions existing in the tropics, would have been impossible but for the kodak system. The combination of heat and moisture incidental to tropical climates tends to melt the photographic emulsion, and, consequently, is fatal to the photographic image. This difficulty is only avoided by developing the films as soon as exposed. The means of doing this in a simple, practical way is supplied by the kodak system.

The kodak system enables the amateur

to go forth on a picture-taking tour with no other equipment than a handful of film cartridges, a kodak, and a daylight developing outfit, which he can tuck under his arm. With this system he can take and develop his pictures anywhere. He is independent alike of climate or dark room. It is the freedom from the ordinary impedimenta of the photographer that makes the system so necessary in these fast-moving modern days.

Canal Army's Recreations

If it be true that those who originate and devise the pastimes of a people are counted among the benefactors of mankind, then those who devoted themselves to the task of providing the means for rational relaxation and amusement for the army of men engaged in the construction work of the Isthmian Canal deserve recognition as having, in no small degree, contributed to the final successful completion of that undertaking.

Among the various forms of amusement provided by the Isthmian Canal Commission for recreation and the promotion of the moral and mental well being of the workers were the two most popular indoor pastimes, billiards and bowling.

During the work there were introduced into the canal territory in the various Y. M. C. A. club houses, gymnasiums and amusement places, under the supervision of A. B. Dickson, forty-two carom and six pocket billiard tables and eighteen bowling alleys.

From time to time all-Isthmian carom and six pocket billiard tournaments, as well as many local tournaments, were held, participated in by from 30 to 100 members. Bowling tournaments were held continually, and often as many as 150 men entered in these contests, from 20 to 30 in each town where alleys were located.

Bowling, especially, was very popular on the zone, helping to keep the men contented and furnishing a light form of exercise greatly appreciated by them.

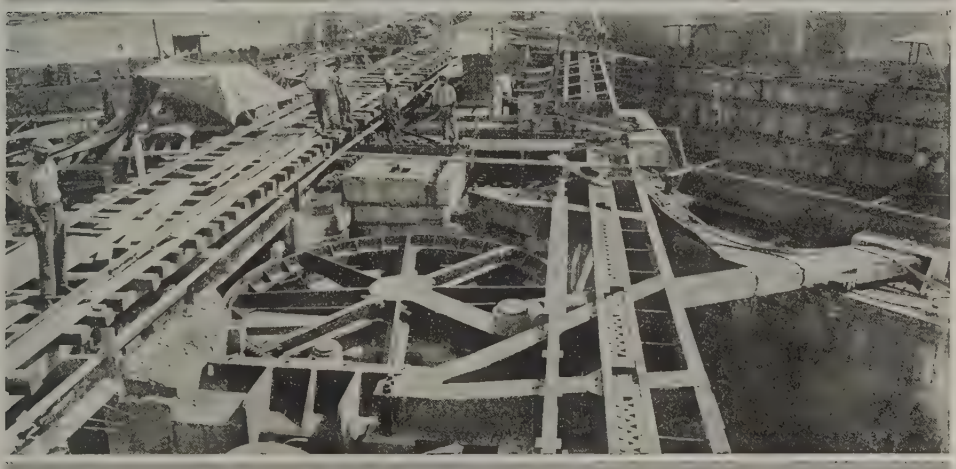
This line of amusement equipment was furnished from the factories of the Brunswick-Balke-Collender Company, the products of whose shops are well known and whose business activities are world-wide.

In spite of the tropical climate, all forms of athletic recreation were in vogue, exactly as in the States. The base ball nine, picked from the best players among the young Americans, played some remarkably sharp games, and the tennis courts were often thronged. Bathing was, of course, a favorite amusement, and prizes for fancy swimming, diving, etc., were offered. With uniforms and outfits furnished by A. G. Spalding & Bros., the athletes of the Isthmus were as well equipped and up-to-date as those in the United States, and the scenes at the base ball, handball, tennis, and other contests were exactly like those at home.

Featured prominently among the provisions made for the amusement and entertainment of the canal officials and employees was the continuous presentation under government auspices of the magnificent spectacles known for many years in the States in connection with the name of "Pain." For more than a quarter of a century, the Pain Fireworks Display Company has given its exhibitions of pyrotechnics in every part of this country, as well as abroad, while in Mexico it is even in greater favor among the pleasure-loving people whose counterpart is to be found in the native population of the Isthmus.

The president and principal owner of the Pain Fireworks Display Company, Harry Bishop Thearle, was for twenty-five years manager of the old company, while its destinies were in the hands of the founder. When the old company failed and Mr. Pain returned to England, Mr. Thearle bought out the business and proceeded to build it up into a strong and durable institution. Under his control its reproductions of historical events have become famous the world over. Among the more notable are, "The Battle in the Clouds," "The Last Days of Pompeii," "Mount Vesuvius," and "Pioneer Days,"







1. Beginning of concrete construction, Gatun Locks, showing cableways for handling concrete.
2. Master wheel and arm for opening and closing gate.
3. Gate beyond vessel is closed, water has reached level of lock in foreground, and vessel is passing through.

as well as at least ten others equally well-known, and as popular today as when they were first produced.

The Pain Fireworks Display Company has factories in New York, Chicago, and San Francisco. During the past few years its expansion has been such that scarcely a celebration of any importance in the United States or Canada is without one of its exhibits.

A firm which contributed to the peace of mind and comfort of the men on the Canal Zone was the Theobald & Oppenheimer Company, of Philadelphia. This firm was the pioneer, and now stands at the head of the field as manufacturers of fine domestic cigars of national reputation.

The success of this company is due to John J. Kolb, a native of the quaint old village of Sandhausen, Baden, Germany, where he made a special study of tobacco and its attributes. On coming to this country he began his career as a cigar maker, becoming identified with his present firm as superintendent in 1896. The firm at that time was a small concern employing some forty or fifty hands.

From the inception of this connection, Mr. Kolb introduced methods in manipulation and handling of tobacco thereto unknown in this country, thereby revolutionizing the cigar industry, increasing the character and style of manufacture, and bringing to the fore the finest product to that time seen on this country's market.

As manager and president of the concern, the guidance of which has been his care and study, he has seen one factory of a few hands grow by leaps and bounds, until he wields the reins over a vast enterprise of his own building, operating numerous factories and employing twenty-five hundred hands.

Philip Morris cigarettes, the world's oldest high grade of Turkish cigarettes, made by Philip Morris & Company, Ltd., of New York City, were used in enormous quantities by the canal army, natives of all the countries represented on the Canal Zone using them constantly. The "Brown Box" in which this tobacco was packed was a familiar object along the route of the canal.

Pay Roll Equipment

For use as advance payment of wages, payable in merchandise from the commissaries or in board at the hotels, commissary coupons were issued to Isthmian Canal and Panama Railroad employees, and meal slips, good for one day's board, to silver employees. All coupon books were charged to the employee receiving them, the charge being made directly in the pay-roll book for deduction from his wages on the next pay day.

Orders for books and meal slips were placed by the commission from time to time from 1907 onward with the Allison Coupon Company, of Indianapolis, Ind., which furnished 5,000,000 books for commissary use in denominations ranging from $2.50 to $15.00, with the separate coupons ranging from one cent to fifty cents. This firm also furnished 500,000 Isthmian Canal Commission hotel books, each containing fifty coupons separately valued at thirty cents. In addition, it furnished 8,000,000 daily meal tickets for silver employees.

These coupons and slips not only simplified bookkeeping and merchandise charges, but actually served as a circulating medium for citizens of all the countries employed at the Canal Zone. The coupons were manufactured at the company's plant at Indianapolis, on special water-marked paper to guard against imitation or counterfeiting, and on special machinery that provided for accuracy in counting and assembling, rapid printing, and prompt shipments.

In 1909, the officials in charge of the sanitary and commissary supply departments, that their transactions might be more accurately and quickly recorded, ordered from the National Cash Register Company, of Dayton, O., sixty-one of its machines.

The machines were built to order on special construction specifications. They were used in the stores for the employees

of the commission and were beautifully nickel-plated to withstand the climate of the Isthmus. Cash registers have long been considered an absolute necessity in stores, even in those doing a small business, for they keep a correct record of all transactions, give a correct total for each of the various classifications, and save a great deal of time in balancing books. The appearance of numerous cash registers on the Isthmus was certain to follow the policy of speed, accuracy and completeness that characterized the canal work, and these machines had no small part in the sum total of equipment that carried the work to an early completion.

In the selection of safes for use in the various offices throughout the Canal Zone, the Isthmian Canal Commission used the same care that prevailed throughout their administration of the entire work, and the purchase of the celebrated York safe, manufactured by the York Safe & Lock Company, of York, Pa., may be regarded as a strong endorsement of their high quality and efficiency.

This company has been a prominent factor in safeguarding the riches of the government in every department. Not only has it provided safes for use along the Panama Canal, but hundreds of them are in use on the battleships of the United States navy and by army paymasters, wherever Uncle Sam's domains extend. It installed the great bond vaults in the United States Treasury Department at Washington, where hundreds of millions in money are stored; also the treasurers' vaults, cash vaults, stamp vaults, and plate vaults in the new bureau of engraving and printing, where ponderous fifty-ton doors protect more riches than the average mind can conceive. It recently constructed similar vaults for the United States Sub-Treasury at San Francisco, Cal.

Natives Discover the Sewing Machine

The sales of machines for domestic or household use from the beginning of the active construction work are hints as to what the opening of the canal will mean to American manufacturers. Before the advent of the American builder probably not a family on what is now the Canal Zone owned a modern American-made sewing machine. The statistics gathered and compiled for the information of the American business public disclose that since the beginning of the active construction work more than 1,500 sewing machines manufactured by the New Home Sewing Machine Company, of New York, have been sold by one representative of the company in Panama City. These were used by natives as well as white residents, and from the Isthmus knowledge of the usefulness of the sewing machine has spread through Central America.

The manufacture of the New Home sewing machine dates back to 1862, in a little factory employing about forty persons. Now the works of the company cover about eleven acres of floor space, and about 1,000 persons are in its employ. It manufactures annually about 150,000 sewing machines, and 12,000,000 sewing machine needles.

Sanitation and Health Appliances

When the United States started on the work of building the canal it was confronted with its greatest problem—the saving of human life—for the experience of the French Company had shown that unless new and more effective methods were introduced to safeguard the lives of those connected with the construction work, thousands of persons would be sacrificed. So strong was the feeling in the United States that to go to the Isthmus was only to encounter disease, if not death, that it was difficult to secure the services of those fitted to make the canal a success.

Investigation developed that two species of mosquito infected the Isthmus, one carrying malarial germs and the other the bacillus of yellow fever. In addition to the question of health the government was also desirous to secure the personal

comfort of those it sent to the Isthmus. So it was that when the Secretary of War sent Gen. George W. Davis to investigate the possibility of constructing the Isthmian Canal, to protect him from the danger of yellow fever germs carried by the mosquito, he contracted with Wickwire Bros., of Cortland, N. Y., to screen the cottage intended for the use of Gen. Davis with their wire cloth made of copper and spelter wire. This was the introduction of wire screens in the canal work. This wire cloth was later adopted by the engineers and government officers for screening all buildings.

The wire cloth used on the Isthmus was especially designed by Wickwire Bros. for use where the ordinary wire cloth would deteriorate because of climatic conditions. The government has used the cloth very extensively in screening lighthouses. The enforced screening of houses on the Canal Zone was one of the effective elements in stamping out yellow fever, thereby saving thousands of lives.

As a part of the warfare against disease on the Canal Zone, the spraying pumps manufactured by F. E. Myers & Bro., of Ashland, O., were early brought into requisition. Following inquiries made by Major Boggs, of the purchasing department, for a pump easily transported and capable of developing a good pressure for applying oils and disinfectants, for use by the sanitary department, this firm submitted its catalogue of pumps, and recommended the use of the Myers Knapsack Pump. Shortly after submitting the proposal, notification was received from Major Boggs that the equipment recommended had been adopted by the commission as being better suited to the needs at the Canal Zone than any other of the various kinds that were offered.

That those pumps gave complete satisfaction is fully evidenced by the orders that followed. The first shipment was made in June, 1905, and consisted of six pumps. This was followed at more or less regular intervals and in increasing numbers, up to July, 1911, by which date a total shipment of 474 pumps had been made.

These knapsacks pumps were used at the canal for spraying low marshy places, swamps, small streams, creeks, and other similar places where the mosquitoes have their breeding places. The pumps are made of galvanized iron and copper, the "knapsack" being carried on the back of the operator in such manner that he can pump and direct the spray at the same time. The copper can or receptacle does not rust or corrode, making it particularly adapted for use in tropical climates. With each pump was supplied an extra length of hose, and additional nozzles and other parts. The commission was careful to specify a pump that was characterized by more than ordinary strength and durability, since those furnished were to be used largely by the natives. The numerous repeated orders indicate that the goods furnished by this firm were especially adapted for the work.

In the battle against the canal mosquito, to prove the efficiency of Phinotas Oil as a destroyer of the mosquito pests, the Phinotas Chemical Company, of New York, sent one barrel of its oil to the Department of Sanitation on the Isthmus, during August, 1907. In September a trial order for 500 gallons was given the company, and in December another order was given, this time for 1,000 barrels. This order so quickly following the test of ten barrels amply testified to the value of the oil. That yellow fever has not been epidemic in the Canal Zone is largely attributed to the efficiency of Phinotas Oil in destroying mosquitoes.

One of the potent agents used by those in charge of the sanitation of the Canal Zone was Chloro-Naptholeum, from the laboratories of the West Disinfecting Company, of New York. It is in fact a germ killer, from five to six times as strong as pure carbolic acid. Used in the hospitals and quarters of the canal workmen, as a cleansing solution it was unexcelled. It cleared away dirt and filth, dissolved grease and fat, and

got to the bottom of cracks and crevices in the floors and walls where germs thrive. Cleanliness was the order of the day on the Isthmus, and to secure this Chloro-Naptholeum was freely used.

The Canal Commission not only drained off all stagnant pools of water, but it put into operation a system by which all objectionable refuse of the different camps, towns, and colonies along the canal reservation was collected and burned in suitable garbage destructor furnaces, of a type furnished by the Morse-Boulger Destructor Company of New York.

Nine furnaces of this kind were located at different points along the canal route. Each destructor consumed ten tons of miscellaneous garbage and refuse every twenty-four hours.

The United States within recent years has had a large part in spreading the lesson of sanitation to tropical countries. Its example at Panama led to emulation in nearly every port city in South America where disease had not already been conquered by modern methods. At Manila, shortly after the American occupation, the United States issued specifications and called for bids for a 130-ton daily capacity destructor for the city of Manila, and here the Morse-Boulger Destructor Company was again successful.

The city of Guatemala was one of the first to take advantage of the lesson taught at Panama. It completed in 1908 a large garbage and waste destructor, and celebrated the event with parades, decorations, and a general three-day holiday, the people rejoicing in the knowledge that from that time on disease and deaths in the city would never rise above the normal rate.

Keeping pace with the development of medical hygiene, the evolution of sanitation and household hygiene in the United States as well as throughout the world during the last thirty years presents a most interesting study. Just as at Panama was developed the last word in medical science in successfully fighting the dreaded yellow fever, so in the buildings of the canal may be seen the last word in modern sanitary equipment.

It is not many years ago that bath tubs and other household sanitation equipment were made chiefly of wood, lined with zinc or copper sheeting, or other material. As late as the '70s, bathroom and lavatory fixtures, however expensive, were entirely encased in wood, and open plumbing was unknown.

For the rapid development of better household sanitation in the United States, the Standard Sanitary Manufacturing Company, of Pittsburgh, Pa., is largely responsible. The first "Standard" porcelain enameled bath was made in 1875, at the plant of the Standard Manufacturing Company, at Alleghany, Pa., now a part of Pittsburgh. At that time the company's capacity and capital was small. It could turn out two baths a day, and the manufacture and sale of baths at this rate was considered remarkable.

From this small organization, with the awakening of public appreciation of sanitation, the company has grown to be the largest in the world in the line in which it is engaged, with its product reaching into every corner of the earth. The present company was incorporated in 1900, with a capital of $5,000,000, which was later doubled. The number of employees is now 5,500, and the combined daily capacity of its factories is 2,000 bath tubs, 2,000 sinks, and 2,000 lavatories, in addition to a large output of miscellaneous fixtures, plumber's brass, and woodwork. Twenty branch stores, showrooms, warehouses and offices are maintained by the company. During its existence it has manufactured and sold over 3,000,000 of its standard bath tubs, 3,000,000 standard lavatories, and more than 10,000,000 miscellaneous fixtures, and while the quality of output has constantly improved, the cost has steadily decreased, so that proper household and building sanitation is now within the reach of all.

The Washington Hotel at Colon, and all

the buildings at Panama which required sanitary equipment are fitted up with Standard supplies, and from the Canal Zone as a starting point, the lesson of household sanitation is spreading throughout the Latin-American countries as part of the result of the battle against sickness and disease won by the Americans on the Isthmus.

Among the other things introduced in the zone for the comfort and convenience of those engaged in the construction work, and of their families, were soap and toilet articles. This may sound like a little thing, but when the human-interest side of it is considered it was one of the important things.

In all probability there is not a household in the United States where the name of Colgate is not known. The firm of Colgate & Company had been in existence a little more than one hundred years when the Commissary Department connected with the canal work purchased for the use of the department its first supply of soaps and toilet articles. In this connection it may not be out of place to say something of the magnitude to which the business of this firm has grown. It was originally established by William Colgate, and his largest soap pan (and it was the largest then in this country) contained but 43,000 pounds. Now the company has twelve kettles, each containing nearly a million pounds, and more than a score of others with a capacity of half a million pounds each.

For the comfort of those on the zone the Commissary Department purchased from the Colgate Company many thousand dollars' worth of their toilet preparations, and many thousands' worth additional were purchased by individual consumers. More than this, the canal has already opened up a large section of the commercial world to this great American industry, and its completion brings all the Pacific States of South America and Mexico into the immediate range of future possibilities.

Mutilations or death appear to be an unavoidable penalty for progressive operations of any great magnitude. It can safely be said that not an ocean steamer, locomotive, or great structure, either building, bridge, or railway, has ever been carried to its completion without one or more of those employed in the work being mangled or otherwise injured. It was so with the Panama Canal. The great steam shovels, derricks, drills, and trains used in constructive work brought about accidents to many of their operators, and amputations resulted in several cases.

It was the purpose of the Isthmian Canal Commission to supply their dismembered employees, irrespective of color, nationality, or character of work engaged in, with the best substitutes procurable, and for this A. A. Marks, 701 Broadway, New York City, probably the largest and best-known artificial limb-maker in the world, was given requisitions by the commission for artificial limbs for the canal employees, beginning January, 1908. Over 200 requisitions were issued up to 1912, and more were needed before the completion of the work.

Most of the legs and arms were built from measurements furnished by the canal hospital surgeons, the patients remaining on the Isthmus. As the limbs arrived from New York they were applied, and the patients were permitted to either go to their homes in retirement, or to return to the work on the canal. A large number of them were able to return to work.

Commissary Equipment

In view of the climatic conditions on the zone, and the general policy of using high-class equipment in all cases, special attention was given the bins and shelving for the stores in the commissary department.

A very extensive equipment for steel bins and shelving was furnished by the Berger Manufacturing Company, of Canton, O. The equipment from this company for the stores at Colon and Balboa alone filled four carloads. An equal amount of

similar equipment was supplied by the company to other parts of the Canal Zone.

The type of construction used was the company's standard closed type of bins and shelving, consisting of solid uprights, backs, and shelves. It is a ledge construction, in which the units which hold the ledge are thirty inches deep, twenty-four and thirty inches wide, and thirty-six inches high. Above the ledge are units of the same width, and fifty-four inches high, making the total height of the complete assembly seven feet and six inches. The load carried on this shelving is approximately 200 pounds per square foot. These bins, as well as being used in the temporary store houses, were installed in the general store house of the permanent building at Balboa. Here there are 108 assemblies of the bins, each approximately sixteen feet long, or about a quarter of a mile of bins seven and one-half feet high. The uprights and backs of these bins are punched for a three-inch vertical adjustment of the shelves, and the shelves are all punched for an approximate horizontal adjustment of dividers. This construction gives the greatest possible flexibility, so that practically any arrangement desired can readily be made. In addition the construction is arranged so that the bin fronts can be added at any time in the future, and thus the shelving construction can at any time be transformed into bins of any depth.

For refrigerating the cold storage department of the canal commissary making ice and ice cream, and for all uses required for ice and refrigeration, refrigerating machinery was supplied by the Ice and Cold Machine Company, of St. Louis, Mo. In one shipment in May, 1910, this company sent six carloads of refrigerating machinery, weighing 24,000 pounds to a car. The refrigerating machines were the Cross compound duplex, with engine of the Corliss type, and compressors of the horizontal double-acting type. They had a capacity of 300 tons of refrigeration daily. These refrigerating machines were of the type used by the large packers of this and foreign countries, and were especially adapted to continuous operation during the entire year, and particularly adaptable to any climate where continuous operation is necessary. The machines furnished the canal commissary were of an especially high grade, designed for the trying climatic conditions of the Isthmus, and using a minimum of steam. The refrigerators were manufactured by American labor in the company's machine shops.

In insulating the cold storage plant at Cristobal, against the exterior walls of concrete eight inches of Nonpareil cork board was laid up in Portland cement, and the exposed surface finished off with marble cement. The interior partitions consisted of two layers of two-inch Nonpareil cork board erected in Portland cement and finished on each side with marble cement. The bottom of the ice freezing tanks was insulated with six inches of Nonpareil cork board laid down in asphalt; the sides and ends with four inches of granulated cork and four inches of Nonpareil cork board. The exposed surfaces of the cork board around the tank were finished off with marble cement. This insulating material was furnished by the Armstrong Cork Company, of Pittsburgh, Pa. In addition, the company furnished for the Canal Commission large numbers of cork life-preservers and ring buoys, and other cork material. Nonpareil cork board has been for a number of years the standard type of cold storage insulation employed by the United States government. It consists of pure granulated cork compressed in board form and baked at a moderate temperature. The natural gum or resin in the cork itself joins the whole mass firmly together. This is the distinctive feature of this material. The advantages that led to its selection for Panama were its remarkable low heat conductivity; the fact that it will not absorb moisture, and hence excludes offensive odors; the ease with which it may be installed; the fact that it occupies a very small space as com-

pared with insulating materials of lower efficiency; and that it is slow burning and fire-retarding.

W. M. Duncan, of New York, whose specialty is the building of high class refrigerators, had a large part in fitting the government's line of ships to Panama with the refrigerators for storing perishable supplies for use on the Canal Zone. He also furnished refrigeration equipment for some of the commissary department buildings on the zone.

Immediately on the beginning of the American régime at the Isthmus, Hutchinson Bros., of Baltimore, manufacturers of furnaces, ranges, and hotel kitchen apparatus, filled an order for ten large ranges. Their construction and wearing qualities secured many duplicate orders as the army on the Canal Zone increased. The shipments continued for more than six years, the equipment growing as the size of the working army grew. The ranges were of steel, varying from four and one-half to twelve foot sizes, and were used at the Isthmus camps, hotels, and hospitals. All were turned out at the Hutchinson factory.

Flour in great quantities was supplied the canal workers by Holt & Company of New York, an old firm which has been a pioneer in American and South American fields of trade, and which therefore naturally had a great share in the business at the canal.

Enormous quantities of coffee were shipped for the use of the men on the Isthmus. In the period between 1908 and 1912 the William B. Harris Company, of New York, dealer in coffees, teas, spices, and cocoa, shipped 827,903 pounds of green coffee, 99,295 pounds of roasted coffee, 99,295 pounds of cocoa, 1,315 pounds of tea, and 31,891 pounds of spices. This firm continued its shipments until the completion of the canal. These supplies were selected for their quality under competitive bids, and were afterward demanded on account of their popularity with the canal army. To meet the climatic conditions on the Zone the tea, spices, and cocoa were supplied in tins, with each tin wrapped in parchment paper and sealed.

In supplying the cooking equipment for the canal army, the city of Baltimore appears to have been the chief resource of the commissary officials. The S. B. Sexton Stove and Manufacturing Company, of Baltimore, furnished for the Canal Zone about 600 cast iron ranges of various sizes, which were used not only in the construction camps, but in the "bachelor" quarters and family housekeeping quarters as well. Many of this company's ranges were shipped through other concerns under separate contracts, all being manufactured in the company's Baltimore shops.

Among the commissary supplies furnished for the canal were the wares manufactured by the Gorham Manufacturing Company, of Providence, R. I. The rise of this company from insignificant beginnings is typical of the American thrift and inventive genius which have helped so greatly to place this country in the front rank of commercial and manufacturing nations.

Its founder was Jabez Gorham, whose itinerant tradings for eighteen years from his small shop in Providence ended in 1831 in a partnership then formed for the manufacture of silver spoons and other small ware. From this partnership Jabez withdrew in 1847 to interest himself in the Eagle Screw Company, which he lived to see built up into a large establishment. His son, John Gorham, who succeeded him, immediately enlarged his father's plant, and in 1850 conceived the idea of entering into the general manufacture of silverware. The process of spoon making had already advanced from crude hand work at a common blacksmith's forge, but, in order to look into its further development, John Gorham made a trip to Europe to investigate methods in England and on the continent. The shops of Sheffield and Birmingham were visited, where his declared intent to make American goods equal to any of England was greeted as a char-

acteristic Yankee boast. John paved the way to the fulfilment of his boast, however, by beginning as a workman in a London establishment, and when he had mastered the details he returned to this country, bringing other skilled workmen with him.

From that time to the present, the progress of the company has been one of uninterrupted success. In addition to its line of silverware, the company has been engaged in the production of plated ware of the highest grade. In 1889 its plant was greatly enlarged through the purchase of thirty acres of land, where buildings were erected for existing needs and with plenty of room for expansion. The present president of the company, Edward Holbrook, has advanced through all its branches from the minor position which he occupied when he came into its employment in 1870, to complete control.

The wares made by the Gorham Company are not confined to silver and electroplate. It has a special department for the designing and manufacturing of metal work of all descriptions, including statuary work, bas-reliefs, tablets, etc. A notable example of this work was the life size statue of Columbus, modeled by the noted French sculptor, Bartholdi, and cast by the Gorham Company and exhibited at the Columbian Exposition at Chicago.

Not the least interesting feature of the history of this company is the consideration that it has paid to the welfare of its employees. In its "Casino," so called, erected at a cost of $40,000, are lunch rooms, sitting rooms, and a library, the administration of which is controlled by committees composed partly of employees and partly of members of the company. The privileges of these quarters are available to the employees at a nominal cost, whatever deficit that may ensue being borne by the company. A "Workman's Loan Association" has also been formed for the benefit of the employees in temporary emergencies, and a pension system having favorable features is carried on by the company, at its own expense, in the interest of the several thousand men and women in its employ.

The Paris Exposition of 1900 awarded the Grand Prix to the Gorham Mfg. Company, and gave the president of the company (Edward Holbrook) the decoration of the Legion of Honor. Awards have also been received by the company as follows: Centennial Exposition at Philadelphia, 1876; International Exposition, Paris, 1889; Columbian Exposition, Chicago, 1893; International Exposition, Buffalo, 1901; International Exposition, St. Louis, 1904.

Food for the Army

Visitors to the canal who were privileged to get a glimpse of the routine inner life will recall a familiar picture of workmen going to their places of labor carrying round yellow tins. Often, as they went, they munched a food poured from the tin into the hand. This food, which played no inconsiderable part in "building" the canal, was the well-known article of diet "Grape-Nuts."

The mention of Grape-Nuts in this connection is peculiarly pertinent. Not merely because Grape-Nuts is a food—for of course proper food was an integral part of the big enterprise—but because it is a cereal food which successfully withstood the effects of a tropical climate. This characteristic of Grape-Nuts was pretty well known, and constituted a cogent reason for its selection for use in the Canal Zone.

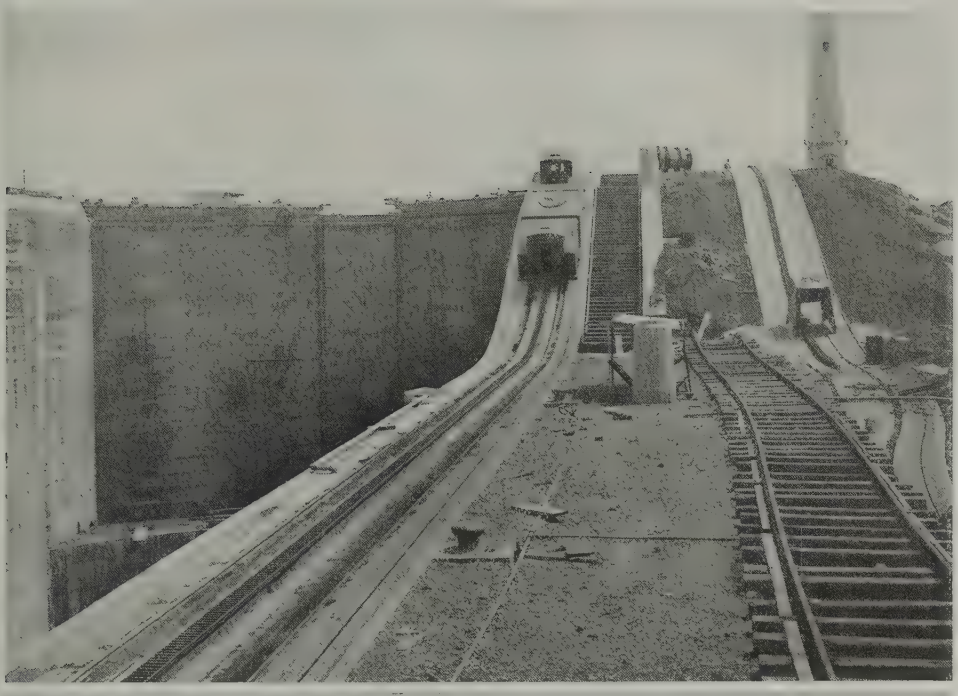
An intimate history of the food problem in the early operations at Panama would make fascinating reading. One of the very first considerations in any such project is the commissary. Indeed, in an enterprise like this, involving the transportation of supplies thousands of miles from the home base, and the feeding of a host, the problem assumes the magnitude of provisioning an invading army.

The purely technical side of the building of the canal was one of the most complex of undertakings. The strenuous efforts of America's foremost engineers were





1. Disrupting effects of the slides in Culebra Cut.
2. Wreck caused by slides.





1. Electric towing locomotives passing from one level to the next one above on the lock walls.
2. View showing size of the wall culverts through which the water is let into or out of a lock chamber to lift a ship up or drop it down.

applied to the gigantic task of overcoming almost insuperable obstacles. But intermixed with the main problem was the seemingly never-ending and quite as important problem of sanitation and diet in their manifold aspects.

The subject of food is intimately related to that of sanitation. It is virtually a part of it, for naturally the problem of supply hinges in great degree on what to supply. As to the deteriorating effects of tropical climates upon foodstuffs, every traveler—especially one who finds it desirable or necessary to remain for a time in such climates—knows well the peculiar obstacles encountered in obtaining foods to which he has been accustomed. Very few of the "home" foods can be had in fresh condition, because of the extreme rapidity with which fresh or exposed food spoils in the tropics.

Particularly is this true of flour and ordinary breadstuffs. The rule, however, finds an exception in Grape-Nuts. This food is so thoroughly baked that it keeps almost indefinitely in any climate, as has been demonstrated again and again. Polar explorers have taken Grape-Nuts with them in their dashes into the Arctic, and travelers have carried the food with them in slow caravan journeys across deserts. One finds Grape-Nuts on transoceanic steamships, in the islands of the seas, in Alaska, South America, Japan, along the China Coast, in Manila, Australia, South Africa, and on highways of travel and the byways of the jungle—in short, wherever minimum of bulk and maximum of nourishment are requisite in food which has to be transported long distances, and often under extreme difficulties. The very enviable reputation which Grape-Nuts has attained in these respects caused it to be chosen as one of the foods for the Canal Zone.

A word as to the nature and processing of this food: Grape-Nuts is made from prime wheat and malted barley, with a bit of yeast and salt. The barley is first malted in order to develop the diastase ferment—a ferment which converts starch into sugar. The malted barley is ground and combined in proper proportions with flour made from whole wheat. A dough is then made, formed into large loaves and baked in highly heated ovens.

These loaves are cooled and afterward baked a second time in slow heat for some twenty hours. From this second baking the loaves come almost rock hard. They are then crushed into the toothsome granules so familiar in the commercial package.

The long, slow baking produces a partially predigested food, for a large percentage of the starch of the grain is thus mechanically converted into grape-sugar (dextrose), in a manner very similar to the change which such food undergoes during natural digestion. The balance of the starchy portions of the grain is thus also thoroughly broken down or dextrinized. Grape-Nuts digests very quickly, usually in about one hour.

This thorough processing prepares Grape-Nuts for long keeping, even under unfavorable conditions, and it has been particularly noted that it is practically never contaminated by proximity to other food products, even if such products should be in a decaying condition. This is in marked contrast to most cereal package goods. For foreign shipment Grape-Nuts is packed in air-tight sanitary tin packages that keep the food fresh and crisp.

Grape-Nuts is ready to eat from the package, and represents probably more concentrated and perfect nourishment than any other prepared cereal. All the valuable phosphates and other minerals of the grain are retained in this food. This cannot be said of most cereal preparations. And yet these minerals, such as phosphorus, sulphur, iron, etc., are regarded by modern science as all-essential for health and for proper building and rebuilding of body, brain, and nerves.

It goes without argument that better and more work can be done on a food of this nature than on foods lacking the vital phosphates. It is also obvious that a food as easily digested as Grape-Nuts is ideal

to 1850 practically every part of shoemaking was a hand process, while to-day a machine performs each of the early processes with greater accuracy, rapidity, and economy, and many new processes. In a large and up-to-date factory as many as sixty different machines are used to make the best shoes for men and women by the Goodyear welt process, and 300 different machines are used in the manufacture of the many kinds of footwear.

That this is an age of machinery, speed, service and system, for the saving of time and expense and the multiplying of product, is shown in no direction more emphatically than in shoe manufacture. The wonderful growth of this industry in the United States, and especially the success and prosperity of the small manufacturer, has been made possible very largely through the machinery and service to be obtained from the United Shoe Machinery Company. And there is a very interesting and valuable example here for all South and Central American countries.

Manufacturers, large or small, obtain machinery on equal and equitable terms. Through its products and expert service the United Shoe Machinery Company lowers the cost of manufacture, simplifies the problems, and facilitates the business of every shoe manufacturer and retailer and helps to bring the best shoes within the reach of all the people.

The United Shoe Machinery Company equips factories with the best shoe machinery in the world, both by direct sale and by leasing or rental. The leasing system in connection with shoe machinery was inaugurated by Gordon McKay in 1861, at the time of the Civil War, when great difficulty was encountered in getting manufacturers to purchase outright machines for sewing the uppers to the soles. This practice of paying for the use of machines, by which the manufacturer was enabled to use his capital in other directions, because of its value and advantages, quickly became an established and permanent feature of the shoe manufacturing industry, and has been so recognized by the 1,200 or more American shoe manufacturers ever since. The application of this system by the United Shoe Machinery Company in Latin-America will prove of similar value to all concerned, and will be the means of stimulating the small shoe manufacturer throughout Central America along the Canal Zone, and in South America.

The varying climatic and topographical conditions existing in the different countries of Central and South America make the shoe problem to a considerable extent a special one for each country, but American invention and mechanical skill have already provided machines adapted to the manufacture of every kind of footwear. The shoe industry is more advanced in some of these countries than in others. To-day, here and there are factories which manufacture light Goodyear welt shoes, turn shoes, and McKays. Under the stimulus of the new conditions it is inevitable that the future will bring a demand for the improved machines and expert attention which have assisted so much in giving American-made footwear its world-wide superiority. The countries which have shoe factories already started will progress further, and those where the industry has not started will take it up. This is as inevitable in Latin America as in those other parts of the world, where a few years ago the making of shoes was limited to native hand processes and methods. The American shoe is growing in favor because of its style, fit, and finish, and American-made machinery will be called into use for local production in order to make a good shoe at a low cost. The native and small manufacturer producing handmade footwear will gradually give way before the factory equipped with American machinery and with American methods of manufacture. The situation is much the same as it was in the United States forty years ago. Since then, and especially in the last twenty years, the growth of the shoe manufacturing industry has been an industrial marvel, impelled by improved machinery and

efficient service. What has been done in the United States is not impossible of repetition in Latin-America.

The commission bought a sample case of boots of the Rubberhide Company, Boston, Mass., in 1908. Then bids were regularly issued for similar merchandise "equal to Rubberhide."

In merchandise of this nature for long, hard, tearing wear in water, the quality of material, workmanship, and peculiarity of construction are the standards of comparison. The judgment of the commission, based upon careful, thorough tests, was given in accordance with the facts.

The Rubberhide Company received all orders on which it submitted prices for the special make of boots demanded by the commission, the specifications being that they should be of "long wear, absolutely watertight, and easy to resole."

The boots furnished by the Rubberhide Company were used by the men employed in concrete construction and other work of a like nature, in which they had to stand in water. The unique feature of the Rubberhide boot consisted in the manner of fastening the leather sole to the upper, by sewing, thus producing a water-tight leather-soled rubber boot that was impervious to water, and which could be resoled without losing its watertight qualities.

The shipping of hats to Panama—supposedly the birthplace and home of the Panama hat—would seem at first thought as unlikely and unprofitable as carrying coals to Newcastle, or exporting Toledo blades to sunny Spain. Nevertheless, there was a demand for hats that all Panama could not supply, and in meeting it American goods scored another, even though unexpected, triumph at the canal.

The succcessful firm in entering and holding the hat market at the Isthmus was Blum & Koch, of New York, hat manufacturer and maker of the only straw hats sold in this country under a recognized trademark. The Panama orders came to the firm entirely unsolicited. There arose a demand at the Zone for Blum & Koch straw hats, which the commissary met at once, and for the last four years of construction the firm made large shipments repeatedly to supply the workers in the tropics with the particular kind of headgear they required.

The John B. Stetson Company, of Philadelphia, received orders for nearly $100,000 worth of fine fur felt hats for workers at Panama.

Felt hats of the high grade produced by this company are recognized as being better adapted for white men who work in the tropics than any other kind of head covering. This is evidenced not only by the heavy orders received from Panama, but by the continual orders from South and Central America generally, Australia, and the Hawaiian and Philippine Islands. Stetson hats have established a reputation the world over as the finest quality that can be made, giving the best service under severe climatic conditions and hard usage.

The Eagle shirts, manufactured by Jacob Miller, Sons & Company, of Philadelphia, Pa., were already well known to the army officers at the canal, and the first order for that necessary article of wearing apparel came to the company from the Isthmus without solicitation. The business carried on by Jacob Miller, Sons & Company is unique in its particular line, as it is the only firm engaged in the shirt industry that both weaves and manufactures its own materials, in verification of its favorite phrase, "From Loom to Wearer." Every shirt sent by the firm to the Isthmus contained a guarantee slip for satisfactory workmanship and durability.

As an indication of the size and needs of the canal army, it is interesting to note that in a single year Isaac Lehmann, export broker and manufacturers' agent, of New York, shipped to the Canal Zone wearing material totaling a quarter million dollars in value. These shipments included overalls, working shirts, and other material for the men, and under the requirements were what is known as the

for hot weather and tropical needs, by reason of the slight expenditure of energy required in digestion and assimilation—producing less body heat in the digestion than with less thoroughly processed or ordinary foods. In addition to its nutritional worth, Grape-Nuts possesses a very pleasing sweetness and delightful flavor. It is not surprising that Canal Zone laborers frequently ate the food dry, and enjoyed it.

It is of interest to note that as early as January, 1906, when the Government Board, in its report on the finish of the accepted type of lock canal, had named January 1, 1915, as the final date, there had already been shipped into the Canal Zone, on order of the Panama Railroad, large quantities of Grape-Nuts, anticipatory of the huge orders that were to follow.

Reverting, as a parting reminiscence of a trip through the Canal Zone, to the details of that complex picture, it is recalled that at certain stages in the progress of the work, one of the suggestive features was the empty yellow Grape-Nuts tins, bearing testimony to the general distribution of a product that has become in a comparatively brief period of time, not only a national, but a world food.

How the cost of living was kept down by the canal authorities has been told in another chapter of this work. A firm that more than did its share in holding down the cost of living for the canal authorities was Sulzberger & Sons Company, of Chicago. From three to seven cars of meat were shipped weekly to the commissary department by the Sulzberger Company. The cars were loaded with hindquarters and straight carcasses of the best corn-fed native steers; hams and bacon, prepared from the finest young porkers, cured by hickory smoke; all the different kinds of sausages; barreled pork, and pure lard and compound. The company also shipped to the commissary department large quantities of canned meats.

The Cudahy Packing Company, of Chicago, supplied the Canal Commission with large quantities of canned meats, beef extract, and barreled beef. The goods were packed under government inspection, requiring the highest quality of products.

The Canal Commission contracted with L. F. Frank & Company, of New Orleans, for a supply of fresh eggs, the demand being for between 25,000 and 30,000 cases annually. The shipments were made weekly, and were packed especially for the voyage to the Isthmus.

Fruit was an important article of diet for the canal army, and enormous quantities of both fresh and canned fruits were consumed during construction. Of the firms which supplied the workers with fresh fruits, probably the one handling the greatest quantity and variety was S. Segari & Company, of New Orleans. With a port accessible to Panama, and with facilities for quick delivery of fruit in good condition, this company had an active share in keeping the canal army plentifully supplied with all kinds of fruit and market produce. Their shipments ran throughout the period of construction, and continued after the canal was completed.

Until the advent of the Americans on the Panama Canal, American butter was little known in Central America. It is a curious fact that nearly all the butter consumed, even on the west coast of Mexico and Central America, was shipped from Europe. Panama received its first American butter from the wholesale and commission firm of Nollman & Company, of New York, which made heavy shipments for the canal army. In the period between Jan. 30, 1909, and Feb. 20, 1913, 14,765 packages of butter in tubs and prints, valued at $288,246, were shipped to the Canal Zone by this firm.

With the establishment of homes along the canal, a new generation of Americans began to appear. In the beginning of the construction period facilities for fresh milk were not good, but the little new-comers found in Mellen's food a timely and satisfying nourishment. Large quantities of

this well-known American product were used on the Canal Zone during its occupation by the construction army.

The export department of the Corn Products Refining Company, of New York, of which George S. Mahana is manager, shipped large quantities of "Karo," together with supplies of modified Erkenbrecher's starch. "Karo" was used by the hotels and restaurants on the Canal Zone, and the starch by the steam laundry at Cristobal. With its introduction on the Canal Zone, and in anticipation of opening the canal, this company increased its facilities for handling business in South and Central America, and its products are expected before long to become as well known in the southern continent as they are in the United States.

Footwear and Clothing

High quality shoes were supplied the canal workers by the Dugan & Hudson Company, of Rochester, N. Y., a firm which made many shipments of shoes that were used by the canal officers and heads of departments, and their families. The laborers' heavier shoes were furnished by other concerns. The Dugan & Hudson contracts, which ran over a number of years, were based on the quality of their product as shown by their submitted samples. The quality of the leather was such that it easily withstood the rigor of the Isthmian climate.

In the three years following the spring of 1910, the Stetson Shoe Company, of South Weymouth, Mass., filled sixteen contracts for fine shoes for the canal army. These shoes were made in one of the best equipped of modern factories, by master workmen in their craft, supervised by shoe experts, and the satisfaction given was evidenced by the long line of contracts.

Another company which furnished shoes in large quantities was the Keiffer Bros. Company, of New Orleans.

The use of the Panama Canal will not only stimulate reciprocal commercial dealings between the United States and the countries to the south, but will also stimulate and broaden the industrial life of every Latin-American country. Not only in exports from and imports to the United States, but in domestic manufactures will there be growth, and there is ample opportunity and room for development there along both these lines.

The imports of boots and shoes, for example, into South America are considerable—and will increase, naturally, under the new conditions—but the nations in the southern hemisphere are so extensive that there is an enormous field undeveloped for the importation from the United States of the manufactured product, and at the same time for the establishment of shoe factories for local manufacture. Particularly in supplying medium grades of footwear is there great opportunity for this branch of domestic industry. Both imported American-made shoes and shoes manufactured on American-made machines in local factories will be a greater feature of commerce and industry than ever before in the twenty Latin-American countries, with an area three times that of the United States and a population seven-tenths as large.

The future development of the Latin-American countries, with their 70,000,000 inhabitants, should follow the history of the United States in many ways. This can be predicted especially in the line of such industries as the manufacture of boots and shoes. This is the eighth largest industry in the United States, and the fourth among manufacturing industries. Over $225,000,000 is invested therein; there are over 200,000 wage earners, and the annual manufactured product is valued at over half a billion dollars. The manufacture of shoes on American standards will be a splendid field for the enterprise of South American business men.

The chief reason why American-made shoes are better, more stylish, and of greater value than any others in the world is because there are now machines to perform the many processes in shoemaking. Prior

standard make in the United States. Under this requirement the canal workers received the very best material at manufacturers' prices.

The question of underwear might be thought insignificant as a factor in the canal building, yet taking into consideration that the bodily comfort of a man to a great degree controls his efficiency as a workman, it can readily be seen it is an important factor. The B. V. D. Company, of New York, furnished thousands of suits for the workmen in the Canal Zone, and its product was found especially adapted to the climatic conditions on the Isthmus.

Among the American firms that contributed their part to the comfort of the thousands of workers on the Panama Canal there is one which congratulates itself upon the fact that its most important manufactured product is trodden under foot all over the world. Nor is it at all strange that it should take pride in this unusual condition, since its main article of manufacture is hosiery—an article which, whether considered from the standpoint of style, attractiveness, durability, or comfort, properly engrosses no little thought on the part of its wearers.

This firm is that of Lord & Taylor, whose "Onyx" hosiery is known in every city and hamlet of the land. Its center of manufacture and wholesale distribution is in New York City, but it also has offices in Boston, Chicago, Philadelphia, and San Francisco, as well as old-world branches in Manchester, Paris, and Chemnitz.

The firm of Lord & Taylor was established in 1826. Lord & Taylor occupy the largest building in America or the world devoted to hosiery, and house the largest supply kept on hand by any firm engaged in a similar business. There is no class of hosiery that is not manufactured by this firm, and the style and make are suited to every climate, adapted to meet every taste, and equal to every occasion, at all prices. This variety in make and cost, together with its unchallenged record for comfort and durability, accounts for its wide use in the Canal Zone, where thousands of pairs were sold to the busy laborers as well as to the clerical and executive forces. Lord & Taylor are also manufacturers of hand made underwear, which line of supplies was likewise largely sold in the Isthmus. Their goods are in demand throughout all of South America—throughout all the world, for that matter, seeing that the inhabitants of England, France, Germany, Russia, Italy, Canada, Africa, and India are numbered among its patrons—its entire output reaching the enormous figure of $10,000,000 a year.

Every device that promised utility was used to make comfortable the condition of the employees engaged in the work of construction. The rays of the tropical sun and the torrential rains were things to be provided against. As an instance of this care and foresight, hundreds of dozens of small and large umbrellas were purchased from the Hulse Bros. & Daniel Company, of New York. This firm supplied from 100 to 300 dozens of these umbrellas each year during the continuance of the construction work. The umbrellas were specially constructed for the Canal Zone, with a view to the best service in tropical countries. Copper wire was used instead of steel, and the handles were riveted on, because in the climate of the Isthmus, the ordinary method of gluing would not have been efficient. Large quantities of umbrellas were of an extra large size, especially desirable during the rainy seasons. In the construction of these umbrellas natural wood rods and bamboo handles were used, owing to their light construction and large spread. Supplying these umbrellas for the comfort of the employees was but a part of the great sanitary measures adopted for the comfort and health of those engaged in the active work, and may be regarded as one of the measures which aided to cut down the rate of mortality to a very low figure for a tropical country.

Other American firms which had part in the canal work were the American Brass

Company, of Waterbury, Conn., supplying brass and other metal appliances; American Railway Supply Company, of New York City, railway equipment; American Metal Company, New York City, metals; American Hay Company, New York City, forage; American Negligee Company, New York City, clothing; Atlantic, Gulf and Pacific Company, New York City, mechanical equipment; the C. H. Alden Company, Abington, Mass., footwear; the R. P. Andrews Paper Company, Washington, D. C., stationery; the G. S. Baxter Company, of New York City, railroad ties; F. A. Branda & Company, New York City, general supplies; A. F. Brombacher & Company, New York City, hardware; Best & Company, Chicago, Ill., white duck material; the Baltimore Hub, Wheel and Manufacturing Company, Baltimore, Md., hubs; Bruce and Cook, New York City, iron pipe; the Buda Company, Chicago, motor engines; the Cleveland Pneumatic Tool Company, pneumatic and other tools; Columbian Facing Mills Company, foundry supplies; Herbert Crapster, New York City, general manufacturers' supplies; Callahan & Meyers, Allentown, Pa.; the H. B. Claflin Company, New York City, dry goods; George B. Carpenter & Company, of Chicago, cordage; the Carter Iron Company, of Pittsburgh, Pa., iron and steel; W. M. Duncan, New York City, refrigeration; the Detroit Hoist & Machine Company, Detroit, Mich., hoisting machinery; John H. Dialogue & Sons, Camden, N. J., propellers; Eimer & Amend, New York City, chemical apparatus; the Electric Controller & Manufacturing Company, Cleveland, O., electrical apparatus; the Barrett Manufacturing Company of Philadelphia, chemicals; the Interstate Iron & Steel Company, Chicago, iron and steel; the Jacobs Candy Company, New Orleans, La., candies; the Kay & Ess Company, Dayton, O., ochre; the Lead Products Company, St. Louis, Mo., lead chemicals; J. H. Leonard & Company, New York City; the Manicure Novelty Manufacturing Company, New York City, manicure supplies; Edgar A. Murray & Company, Detroit, Mich., chemicals; the Magor Car Company, New York City, cars; the W. J. Oliver Manufacturing Company, Knoxville, Tenn., machinery; the Phoenix Knitting Works, Milwaukee, Wis., knit goods; the Ransome Concrete Machine Company, Dunellen, N. J., concrete mixing and other machinery; Stevenson Brothers & Company, Philadelphia, oils; the Monarch Steel Castings Company, Detroit, Mich., steel castings; the Stonega Coke & Coal Company, Philadelphia, coke; Sudeman & Dolson, Galveston, Tex., construction supplies; the United States Metal Products Company, College Point, L. I., metal materials; R. C. Williams & Company, New York City, groceries; the Whelock Reinforced Cork Boat Company, New York City, boats; the Western Railway Equipment Company, St. Louis, Mo., railway supplies; J. H. Weil & Company, Philadelphia, lifting jacks; Union Tool Company, Torrance, Cal., tools.

The foregoing chapter gives a general outline of the character and quality of the manufacturing products and industrial efforts which entered into canal construction. More than 3,000 American firms, a comprehensive list of which follows, had the privilege of participating to some degree in the crowning feat of human enterprise. All of them may be justly proud of their share and ready coöperation in contributing to prompt construction, and to the comfort of the canal army of employees; and of them the American business world may also be proud, as exemplifying in high degree the best that American industry and commercial ability affords. Many monuments will arise in honor of the men who dug the canal; and there might appropriately be one to the American business men, who, often to their heavy financial loss, stood shoulder to shoulder with the workers at Panama in assisting the United States speedily and successfully to complete America's great donation to the commerce of the world.

CHAPTER LIII

INDUSTRIAL ROLL OF HONOR, PANAMA CANAL

LIST OF AMERICAN PERSONS, FIRMS, AND CORPORATIONS WHO SUPPLIED EQUIPMENT FROM THE UNITED STATES FOR THE BUILDING OF THE PANAMA CANAL.

A

Abbey Effervescent Salt Co., Medicines, Montreal.
Abendroth & Root Mfg. Co., Piping Boilers, N. Y. C.
Abercrombie & Fitch, Sporting Goods, N. Y. C.
Abraham Friedman, Shoes, St. Louis, Mo.
Acme Evans Co., Flour, Indianapolis, Ind.
Acme Lumber Co., Doors, New Orleans, La.
The Acme Road Machinery Co., Rock Crusher, Frankfort, N. Y.
Acorn Lumber Co., Lumber, Pittsburgh, Pa.
J. J. Adams & Co., Brushes, Brooklyn, N. Y.
Adams & Grace Co., Stationery, New York City.
The Adams & Westlake Co., Railway Supplies, Philadelphia, Pa.
Byron S. Adams, Certificates, Washington, D. C.
R. H. Adams, Linseed Oil, New York City.
The Addressograph Co., Addressing Machines, N. Y.
A. Adler & Co., Canned Goods, New Orleans, La.
Karl Adlers, Creamery Supplies, New York City.
Adriance, Platt & Co., Mowers, Poughkeepsie, N.Y.
The Aetna Powder Co., Electric Fuses, Aetna, Ind.
The Ahrens & Otto Mfg. Co., Kitchen Sinks, Louisville, Ky.
Ajax Forge Co., Switches, Chicago, Ill.
The Ajax Metal Co., Philadelphia, Pa.
Akron Metallic Gasket Co., Gaskets, Akron, Ohio.
Alberger Pump & Condenser Co., Parts for Pumps, New York City.
Albert Mackie Grocery Co., Groceries, New Orleans.
Chester B. Albree Iron Works, Iron and Steel Goods Allegheny, Pa.
Alcohol Utilities Co., Chemicals, New York City.
The Aldon Co., Car Replacers, Chicago, Ill.
C. H. Alden Co., Shoes, Abington, Mass.
Andrew Alexander, Shoes, New York City.
Alexander Lumber Co., Ltd., Lumber, Alexandria, La.
Edgar Allen Am. Manganese Steel Co., Chicago, Ill.
Alsens Am. Portland Cement Co., Cement, N. Y. C.
Allen's Anti-Rust Co., Paints, Cincinnati, Ohio.
Allis-Chalmers Co., Crushers, Milwaukee, Wis.
The Allison Coupon Co., Coupon Books, Indianapolis.
D. S. Alpaugh & Co., Commission Merchants, N. Y.
Alpha Portland Cement Co., Cement, Easton, Pa.
B. Altman & Co., Dry Goods, New York City.
Aluminum-Rawhide Artificial Limb Co., Limbs, N.Y.
A. S. Alve Instrument Co., Scientific Instruments, St. Louis, Mo.
Amalgamated Paint Co., Paint, New York City.
Amberg File & Index Co., Files, Chicago, Ill.
Am. Agricultural Chemical Co., Fertilizers, N. Y. C.
Am. Arc. Lamp Co., Arc Lamps, Kalamazoo, Mich.
Am. Bank Note Co., Bank Notes, etc., N. Y. C.
The Am. Bitumastic Enamels Co., Enamel, Philadelphia, Pa.
American Blower Co., Blowers & Heaters, N. Y. C.
Am. Brass Co., Brass Appliances, Waterbury, Conn.
Am. Bridge Co., Structural Steel Goods, N. Y. City.
Am. Butter Cutting Mach. Co., Butter Cutting Machines, New York City.
American Calorific Co., Chemicals, New York City.
American Circular Loom Co., Chelsea, Mass.
American Company, New York City.
Am. Cotton Oil Co., Cotton Oil, New York City.
American Crayon Co., Crayons, Sandusky, Ohio.
Am. Creosote Wks., Ltd., Creosote, New Orleans.
The Am. Distributing Co., Wood Alcohol, N. Y. C.
Am. Duplicator Co., Duplicator Compound, N. Y.C.
Am. Elec. Works, Copper Wire, Phillipsdale, R. I.
American Emery Wheel Works, Providence, R. I.
Am. Fire Apparatus Co., Fire Apparatus, N. Y. C.
American Frog & Switch Co., Railway Appliances, Hamilton, Ohio.
American Fruit Produce Co., Apple Products, N. Y.
Am. Gasaccumulator Co., Range Lights, Philadelphia.
American Glue Co., Glue, New York City.
American Hay Company, Oats and Hay, N. Y. C.
American Hoist & Derrick Co., Rope & Cranes, St. Paul, Minn.
American Iron & Steel Mfg. Co., Iron and Steel, Lebanon, Pa.
Am. Iron & Steel Milling Co., Steel & Iron, N. Y. C.
American Knife Co., Cutlery, New York City.
American La France Engine Co., Steam Fire Engine, Elmira, N. Y.
Am. Laundry Mach. Co., Laundry Mach., N. Y. C.
American Lead Pencil Co., Pencils, New York City.
American Linseed Co., Oils, New York City.
Am. Locomotive Sander Co., Locomotives, Philadelphia, Pa.
Am. Malleables Co., Malleable Iron Castings, N.Y.C.
American Manganese Bronze Co., Material for Spillway Gates, New York City.
American Mfg. Co., Rope, St. Louis, Mo.
American Mercantile Co., Piles, Tacoma, Wash.
The Am. Metal Co., Ltd., Copper, Ingot, N. Y. C.
The American Metal Hose Co., Metal Hose, N. Y. C.
American Milling Co., Dairy Feed, Chicago, Ill.
Am. Negligee Co., Dry Goods, New York City.





1. Side view of dirt spreaders at work on the dumps.
2. Front view of same.

Am. Powder Mills., Fuse & Triple Tape, Chicago, Ill.
Am. Preserving Co., Food Products, Philadelphia.
Am. Ry. Device Co., Ry. Appliances, Chicago, Ill.
American Railway Supply Co., Laborer's Identification Checks, Police Caps, Coats, etc., N. Y. C.
American Road Machine Co., Spreaders, N. Y. C.
American Rolling Mill Co., Pipe, Middletown, Ohio.
American Rotary Valve Co., Vacuum Cleaning System, New York City.
Am. Rubber Mfg. Co., Rubber Goods, Emeryville, Cal.
American Safety Lamp & Mine Supply Co., Cylinder Plugs, Scranton, Pa.
Am. Sales Book Co., Sales Books, New York City.
American Screw Co., Providence, R. I.
Am. Sewer Pipe Co., Vitrified Sewer Pipe, Akron, O.
Am. Ship Windlass Co., Ship Equip., Providence.
American Specialty Mfg. Co., New York City.
Am. Spiral Pipe Works, Riveted Pipe, Chicago, Ill.
Am. Stamp Mfg. Co., Dating Stamps, N. Y. C.
American Steam Gauge & Valve Manufacturing Co., Safety Valves, Boston, Mass.
American Steam Gauge & Valve Manufacturing Co., Safety Valves, New York City.
Am. Steel & Wire Co., Steel & Wire, Chicago, Ill.
Am. Steel Foundries, Iron & Steel Goods, Chester, Pa.
Am. Steel Foundries, Steel Castings, Chicago, Ill.
American Sugar Refining Co., Sugar, New York City.
American Tag Co., Tags, New York City.
Am. Tie & Timber Co., Lumber, New York City.
American Tin Can Co., Tin Cans, New York City.
American Tobacco Co., Tobacco, New York City.
Am. Tool Wks. Co., Lathes, Planes, Drills, Cincinnati.
The American Towing & Lighting Co., Tug Boat, Baltimore, Md.
American Track Barrow Co., Lowell, Mass.
American Trading Co., Cement, New York City.
American Type Founders Co., Fixtures, Job Folders, Philadelphia, Pa.
American Typewriter's Co., Philadelphia, Pa.
American Watchmen's Time Detector Co., Electrical Watchmen's Clocks, New York City.
Am. Water Softener Co., Chemicals, Philadelphia.
Ames Iron Works, Iron and Steel, Philadelphia, Pa.
Anchor Packing Co., Packers, New York City.
R. P. Andrews Paper Co., Paper Supplies, Wash., D.C.
Annin & Co., Flags, New York City.
Anniston Cordage Co., Braided Cotton Sash Cord, Boston, Mass.
H. M. Anthony, New York City.
Apollinaris Agency Co., Mineral Water, N. Y. C.
Appel & Ujffy, Com. Merch., New Orleans, La.
J. Applegate & Co., Oysters and fish, New York City.
The Aqualite Fireproof Paint Co., Paint, N. Y. C.
Aqudneck Manufacturing Co., Newport, R. I.
Arbuckle Bros., Coffee, New York City.
R. S. Arcia, Supplies at Isthmian Hospital, Colon, Panama.
Arkay Rubber Co., Rubber Bands, New York City.
Arlington Manufacturing Co., Paints, N. Y. C.
The Armitage Mfg. Co., Coal Tar, Richmond, Va.
Armour & Co., Tallow and Glue, Chicago, Ill.
Armspear Manufacturing Co., Lanterns, N. Y. C.
Armstrong Box & Cork Co., New York City.
Armstrong Bros. Tool Co., Tool Holders, Chicago.
Armstrong Cork Co., Life Preservers, Cork Board, Pittsburgh, Pa.
Armstrong Iron Works, Washers, Vineland, N. J.
Armstrong, Walls & Co., New York City.
L. C. Arney, Cider, New Orleans, La.
J. H. Arnold, Stencils, New York City.
Art Metal Construction Co., Steel Office Fixtures, Jamestown, N. Y.
Henry Aschenbach Harness Co., Harness, N. Y. C.
Ashcroft Mfg. Co., Steam Gauges & Indicators, N.Y.
Ashland Fire Brick Co., Fire Clay, Ashland, Ky.
The Ashton Valve Co., Valves, New York City.
Atha Steel Castings Co., Steel Castings, Newark, N.J.
E. C. Atkins & Co., Saws, New York City.
Atlantic & Southwestern Broom Co., Brooms, Baltimore, Md.
Atlantic Creosoting & Wood Preserving Co., Creosoted Piles, Norfolk, Va.
Atlantic Equipment Co., Rock Buckets, N. Y. C.
Atlantic Grindstone Co., Grindstones, Providence.
Atlantic Gulf & Pacific Co., Dredge Equipment, N.Y.
Atlantic Hotel & Supply Co., Packers, N. Y. C.
Atlantic Insulated Wire & Cable Co., Copper Wire, New York City.
Atlas Car & Manufacturing Co., Locomotives, Electric Road Cars, Cleveland, Ohio.
Atlas Coal & Coke Co., Coke, Baltimore, Md.
The Atlas Export & Trading Co., Boiler Tubes, N. Y.
Atlas Portland Cement Co., N. Y.
William C. Atwater & Co., Coal, New York City.
D. Auerbach & Son, Candy, New York City.
The August Maag Co., Baltimore, Md.
Austin Mfg. Co., Well Drilling Machines, Steel Sprinklers, etc., Chicago, Ill.
The Automatic Time & Stamp Co., Time Stamps, Boston, Mass.
Auto Coil Co., Motor Equipment, Jersey City, N. J.
Auto Engine Stop Co., Motor Equipment, Sheboygan, Mich.

B

B. V. D. Co., Dry Goods, New York City.
Babbitt's Mfg. Co., Cleaning Powder, N. Y. C.
The Babcock & Wilcox Co., Boilers, Water Tubes, New York City.
Simon Bache & Co., Glass, New York City.
A. Backuss, Woodware, Detroit, Mich.
A. S. Bacon & Sons, Block & Sills, Savannah, Ga.
Vajen Bader Co., Richmond, Va.
E. B. Badger & Sons Co., Fire Extinguishers, Boston.
Baer Bros., Bronze Powders, New York City.
Baird Machinery Co., Steam Hammers, etc., Pittsburgh, Pa.

Baker, Carver & Morrell, Machinery Supplies, N. Y.
The William C. Baker Co., Handles, New York City.
A. Baldwin & Co., Hardware, New Orleans, La.
Frank Baldwin & Son, Freight Trucks, N. Y. C.
Baldt Anchor Co., Anchors, Chester, Pa.
Balfour, Guthrie & Co., Tacoma, Wash.
Ballard & Ballard, Louisville, Ky.
Ball Engine Co., Engines, Erie, Pa.
William Ballentyne, Books, Washington, D. C.
Baltic Electric Supply Co., Elec. Material, N. Y. C.
Baltimore Bridge Co., Girders, Running Crane, Plate Girders, Baltimore, Md.
Baltimore Hub Wheel & Mfg. Co., Bows, Baltimore.
The Baltimore Steel Co., Base Plates, New Castle, Del.
Bernard Bandler & Son, Carbons, New York City.
F. S. Banks & Co., Wrenches, New York City.
Barber & Ross, Hardware, Washington, D. C.
B. S. Barnard & Co., Conduits, New York City.
Barnhart Bros. & Spindler, Type Foundry Supplies, Washington, D. C.
Albert J. Barnes, Wrenches, Engines, N. Y. C.
W. F. & J. Barnes, Rockford, Ill.
Barnett & Brown, Hose Supplies, New York City.
Barrett Mfg. Co., Coal Tar Liquid, Philadelphia, Pa.
J. Barre & Co., Electrical Supplies, New York City.
James S. Barron & Co., Trucks, Wheelbarrows, N. Y.
L. Barth & Son, Hotel Supplies, New York City.
Bassett-Presley Co., Angles, Cleveland, Ohio.
Bates Mfg. Co., Numbering Machines, N. Y. C.
A. J. Bates, Shoes, New York City.
Battleship Mfg. Co., Wearing Apparel, New Orleans.
Alber E. Bauer, New York City.
Ludwig Baumann & Co., Desks, New York City.
J. Baumgarten & Sons, Rubber Stamps, Brass Checks, Washington, D. C.
Bausch & Lomb Optical Co., Optical Goods, Rochester, N. Y.
G. S. Baxter & Co., Ties, New York City.
Bay Shore Lumber Co., Lumber, Mobile, Ala.
Beall Bros., Tools, Chicago.
J. W. Beardsley Sons Co., Shredded Codfish, N. Y.
The Becker Mill Co., Door and Window Casings, Marietta, Ohio.
Becker-Brainard Milling Machinery Co., Machines, Hyde Park, Mass.
Beedleston & Woerz, Liquors, N. Y. C.
J. L. Beers & Co., Com. Merchant, New Orleans, La.
H. Behr & Co., Abrasive Paper and Cloth, N. Y. C.
Belber Trunk & Bag Co., Trunks, N. Y. C.
Belding & Franklin Machine Co., Potato Peeling Machines, New York City.
Bell & Bogart Soap Co., Soap, New York City.
Bellaire Bottle Co., Bottles, Bellaire, Ohio.
Belknap Hardware & Mfg. Co., Hardware, Louisville, Ky.
The Belknap Wagon Co., Trunks, Grand Rapids, Mich.
Belle Meade Sweet Makers, Candy, Trenton, N. J.
Bellingham Bay Improvement Co., San Francisco.
Benedict Commission Co., Ltd., Commission Merchants, New Orleans, La.
E. M. Benford, Spark Plugs, Mt. Vernon, N. Y.
Bentell & Margedant Co., Car Bearings Machine, Hamilton, Ohio.
Bergen, Crittenden Milling Co., Flour, Milwaukee.
Berger Mfg. Co., Sheet Metal Products, Canton, O.
C. L. Berger & Sons, Scientific Instruments, Boston.
Berlin Constn. Co., Structural Steel Bridges, New York City.
Berlin & Jones Envelope Co., Stationery, N. Y. C.
Berlin Machine Works, New York City.
Berlin Machine Works, Timber, Planer, Beloit, Wis.
Jacob Bernheimer & Bros., Dry Goods, N. Y. C.
Bernstein Mfg. Co., Canvas Bunks, Bedsteads, Philadelphia, Pa.
Otto Bernz, Newark, N. J.
Berry & Aikens, Philadelphia, Pa.
Berry Bros., Varnish & Shellac, New York City.
Berwind-White Coal Mining Co., Coal, New York C.
W. N. Best American Calorific Co., Ovens and Furnaces, New York City.
W. N. Best, Oil Burners, New York City.
Best & Company, White Duck Cloth, Chicago, Ill.
Bethlehem Foundry & Machine Co., Steel Supplies, S. Bethlehem, Pa.
F. S. Betz Co., Dental Supplies, Hammond, Ind.
J. S. Biesecker, Dairy Supplies, New York City.
Bigelow & Dowse Co., Hardware, Boston, Mass.
Billings, King & Co., New York City.
The W. Bingham Co., Tacks, Cleveland, Ohio.
The Bird-Archer Co., Boiler Chemicals, N. Y. C.
J. A. & W. Bird Co., Felt, Boston, Mass.
F. W. Bird & Son, Insulating Sheathing Paper, East Walpole, Mass.
Fred Bischoff Co., General Supplies, N. Y. C.
Bischoff & Co., Cocoa & Chocolate, Brooklyn, N. Y.
Bishop Furniture Co., Furniture, Grand Rapids, Mich.
The Robert Bishop Mfg. Co., Waste Cotton, Boston.
The F. Bissell Co., Insulators, Toledo, Ohio.
Eugene G. Blackford, Fish, New York City.
Blackstone's Sons, Books, Philadelphia, Pa.
Blackall & Baldwin Co., Centrifugal Pumps, N. Y.
George F. Blake Manufacturing Co., Water and Steam Pumps, New York City.
The Blake & Knowles Steam Pump Works, Pumps, N. Y. C.
John Blakeley & Son, Philadelphia, Pa.
Blaw Steel Constn. Co., Steel Frames, Pittsburgh, Pa.
Blaisdell Mach. Co., Air Compressors, Bradford, Pa.
Bleecker & Simons, Tea, New York City.
Block Bros., Tobacco, New York City.
Bliss & Perry Co., Shoes, Newburyport, Mass.
The Blog Shoe Finding Co., New York City.
Bloomingdale Bros., Department Store, N. Y. C.
Blum Bros., Clothing, New York City.
Blum & Koch, Hats, New York City.
Bobbie Foundry & Machine Co., New York City.

Bodley Wagon Co., Dump Carts and Wagons, Memphis, Tenn.
Henry A. Bogardus & Co., Gauges, Chicago, Ill.
Jacob Bokenjohn, Com. Merchant, New Orleans, La.
Bond Scale Co., Los Angeles, Cal.
Charles Bond & Co., Philadelphia, Pa.
B. F. Bond Paper Co., Paper, Washington, D. C.
Borden's Condensed Milk Co., Condensed Milk, N.Y.
Borsum Bros., Metal Polish, New York City.
Borum Hat Co., Hats, New York City.
Louis Bossert & Son, Doors, Sashes, etc., N. Y. C.
Boston Belting Co., Belting, Boston, Mass.
Boston & Lockport Block Co., East Boston, Mass.
Boston Steamship Co., Steamers, Boston, Mass.
Boston Woven Hose & Rubber Co., Steam Hose, Cambridge, Mass.
Boston & Lockport Block Co., Blocks, E. Boston, Mass.
H. E. Boucher Manufacturing Co., Handles, Copying Pencils, Black Paint, New York City.
Maurice Bouvier, New York City.
Bowman-Edson, General Supplies, N. Y. C.
Bowers Rubber Works, Rubber Goods, Contra Costa, Cal.
S. F. Bowser & Co., Oil Pumps, Ft. Wayne, Ind.
George P. Boyce, Dry Goods, New York City.
James Boyd & Bro., Philadelphia, Pa.
John Boyle, Drugs, New York City.
Bradley, Currier Co., Doors, Sashes, New York City.
Bradley & Hubbard, New York City.
C.C.Bradley & Son, Power Hammers, Syracuse, N.Y.
The Brady Brass Co., Brass Castings, N. Y. C.
Bramhall Deane Co., Ranges, New York City.
F. A. Branda & Co., Pipe, Government Contractors, New York City.
F. A. Brander & Co., New York City.
Isaac Brandon & Bros., Wholesale Groceries, N. Y.
Brandt Casher Co., Automatic Cashiers, Chicago.
Brennan Motor Mfg. Co., Motors, Syracuse, N. Y.
Bretch, B. S., Co., New York City.
Gus V. Bretch, New York City.
Briarcliff Farms, Dairy Products, New York City.
Bridgeport Brass Co., Copper Tubing, N. Y. C.
Bridgman Bros. Co., Valves, Philadelphia, Pa.
J. G. Brill Co., Car and Truck Builders, Philadelphia.
Brinsdown Lead Co., Ltd., New York City.
Bristol Co., Voltmeters, Waterbury, Conn.
Briscoe Mfg. Co., Garbage Cans, Detroit, Mich.
British Am. Tobacco Co., Tobacco, New York City.
Broderick & Bascom Rope Co., Rope Cables, St. Louis, Mo.
A. F. Brombacher & Co., Hardware, N. Y. C.
The Bronze Metal Co., Brass, New York City.
Brooklyn Specialty Manufacturing Co., Laundry Machinery, Brooklyn, N. Y.
Brooklyn Varnish Mfg. Co., Oils & Var., B'kl'n, N.Y.
E. J. Brooks & Co., Railway Supplies, N. Y. C.
W. B. Brouard, New York City.
The Brown Shoe Co., Shoes, St. Louis, Mo.
Brown & Bailey, Boxes, New York City.
Buster Brown Hosiery Mills, Hosiery, N. Y. C.
Brown & Co., Inc., Iron, Pittsburgh, Pa.
W. B. Brown Co., Stationery, New York City.
Brown & Sharp Mfg. Co., Machines, Providence.
The Brown Hoisting Machinery Co., Hoisting Equipment, Cleveland, Ohio.
F. A. Brownell Motor Co., Motor Parts, Rochester.
The Browning Engineering Co., Wrecking and Coaling Cranes, Cleveland, Ohio.
Browning, King & Co., Men & Boys' Clothing, N. Y.
Brownrigg & Stevenson, Rubber Goods, N. Y. C.
Bruce & Cook, Boiler Plate, New York City.
Bruen Ritchey Co., Drugs, New York City.
Brunswick Balke-Collander Co., Amusement Devices, New York City.
Bryan & Company, Detroit, Mich.
Bryant Zinc Co., Zinc Material, New York City.
John Bryne & Co., Books, Washington, D. C.
T. S. Buck Mfg. Co., Flexible Stamps, N. Y. C.
Buckeye Engine Co., Engines, Salem, Ohio.
Buckeye Paint & Varnish Co., Lampblack and Putty, Toledo, Ohio.
The Buckeye Steel Casting Co., Steel Castings, Columbus, Ohio.
Bucyrus Co., Steam Shovels, S. Milwaukee, Wis.
Buda Foundry & Manufacturing Co., N. Y. C.
The Buda Co., Switches, etc., Chicago.
Buff & Buff Manufacturing Co., Rivets, Boston.
Buffalo Foundry Supply Co., Sea Coal, Buffalo, N.Y.
Buffalo Forge Co., Engine, Buffalo, N. Y.
Buffalo Gasolene Motor Co., Motors, Buffalo, N. Y.
Buffalo Milling Co., Flour, Philadelphia, Pa.
Buffalo Steam Pump Co., Pumps, New York City.
Buffalo Steam Roller Co., Steam Rollers, Buffalo.
Buhl Malleable Co., Iron Castings, Detroit, Mich.
Edward E. Buhler Co., Bldg. Supplies, N. Y. C.
Builders Iron Foundry, Pipe and Meter Tube, Providence, R. I.
J. H. Bunnell & Co., Electric Supplies, N. Y. C.
Burke & James, Chicago, Ill.
Burnham & Morrell, Canned Goods, Portland, Me.
E. Reed Burns, Elec. Plating Outfit, Brooklyn, N. Y.
Jabez Burns Sons, Machinery, New York City.
E. W. Burr, Provisions, New York City.
Burroughs Adding Machine Co., Adding Machines, Detroit, Mich.
Burroughs Adding Machine Co., Adding Machines, Washington, D. C.
E. T. Burrowes Co., Billiard & Card Tables, N. Y. C.
E. T. Burrowes Co., Wire Cloth, Portland, Me.
Burton Bros. & Co., Dry Goods, New York City.
Burton & Davis, Chemicals, Grocery, Cannery, N.Y.
Charles W. Butler, Desks, Washington, D. C.

C

C. & C. Elec. & Mfg. Co., Elec. Machines, N. Y. C.
The C. & C. Fire Hose Co., Fire Hose, Canton Junction, Mass.

Glen Cairn Mfg. Co., Shoestrings, Pawtucket, R. I.
The California Asphaltum Co., Asphalt, N. Y. C.
California Fruit Canners Association, Fruits, San Francisco, Cal.
Callahan & Meyers, Shoes, Allentown, Pa.
Emil Calman & Co., Varnishes, New York City.
Camden Iron Works, Hydrants, Camden, N. J.
Camel Co., Chicago, Ill.
A. S. Cameron Steam Pump Works, Pumps, N.Y.C.
Alfred J. Cammeyer, Shoes, New York City.
Camp & Heaton Co., Lumber, Lumberton, Miss.
Camp & Hinton Co., New Orleans, La.
William G. Campbell, Stationery, New York City.
Braxton W. Campbell, Cincinnati, Ohio.
J. Campbell Soup Co., Soups, Camden, N. J.
Campbell Electric Co., Lynn, Mass.
Canadian Milling & Evaporator Co., Flour, El Reno, Okla.
Candee, Smith & Howland Co., Masons' Materials, New York City.
A. L. Canfield, Cooking Ranges, New York City.
H. Cannon & Co., R. R. & Contr. Sup., Chicago, Ill.
Cape Fear Chemical Co., Oil, New York City.
Caplan, Frand & Denner, Clothing, N. Y. C.
The Carborundum Co., Wheels, Niagara Falls, N. Y.
Carbolineum Wood Preserving Co., Carbolineum, New York City.
Carbondale Calcium Co., Chemicals, N. Y. C.
Carbondale Mfg. Co., Machinery, New York City.
The Philip Carey Mfg. Co., Cement, Cincinnati, O.
Carlisle Commission Co., Hay, Kansas City, Mo.
Carpenter Steel Co., Steel, Reading, Pa.
George B. Carpenter & Co., Sash Cords and Manila Rope, Chicago, Ill.
L. H. Carr & Co., Bedding, Brooklyn, N. Y.
William Carroll & Co., Inc., Hats, New York City.
Carter Iron Co., Iron, Pittsburgh, Pa.
The Carton Belting Co., Dressing Belt, Boston, Mass.
Casco Bay Packing Co., Fish & Oysters, Freeport, Me.
John A. Casey Co., Naval Supplies, New York City.
The Casey-Hedges Co., Pipe, Chattanooga, Tenn.
John Cassidy, New York City.
T. P. Castle, Ranges, Quincy, Ill.
Castner, Curran & Bullitt, Inc., Smokeless Coal, N.Y.
Cataract City Milling Co., Flour, Niagara Falls, N.Y.
Cataract Refining & Mfg. Co., Cutting Compound, Buffalo, N. Y.
C. J. Caughey, Groceries, New York City.
J. H. Cautier & Co., Jersey City, N. J.
Cavanaugh Bros. & Co., Wholesale Druggists, N. Y.
Cella Bros., Inc., Macaroni and Spaghetti, groceries, New York City.
Central American Construction Co., Ltd., Construction Work, Colon, Panama.
Central Elec. Co., Electrical Supplies, Chicago, Ill.
Central Metal & Supply Co., Valves, Baltimore, Md.
Cereal Food Company, Peoria, Ill.
William H. Chafe, Emery Cloth, Cambridge, Mass.
Champman Valve Manufacturing Co., Gate Valves, Indian Orchard, Mass.
Chandler Bros. & Co., Bankers and Brokers, Philadelphia, Pa.
The Charles Nelson Co., San Francisco, Cal.
Charlotte Leather Belting Co., Leather Belting, Charlotte, N. C.
John Chatillon & Sons, Scales, New York City.
Chatland & Lenhart, Cracker Mfrs., Brownsville, Pa.
Chattanooga Car & Foundry Co., Castings, Chattanooga, Tenn.
The Chattanooga Pipe & Foundry Co., Pipe, Chattanooga, Tenn.
The Chemical Importing & Mfg. Co., Prussiate Potash, New York City.
Chesapeake & Ohio Coal & Coke Co., Coal, Washington, D. C.
Chicago Bearing Metal Co., Car Journal Bearings, Chicago, Ill.
Chicago Bridge & Iron Works, Tanks, Chicago, Ill.
Chicago Belting Co., Belting, Chicago, Ill.
Chicago House Wrecking Co., Chicago, Ill.
Chicago Lumber & Coal Co., Lumber, St. Louis, Mo.
Chicago Pneumatic Tool Co., Pneumatic Tools, Chicago, Ill.
Chicago Steel Tape Co., Chicago, Ill.
Children's Vehicle Corporation, Baby Carriages, East Templeton, Mass.
Chilton Paint Co., Varnish, Long Island, N. Y.
Chisholm & Moore Mfg. Co., Traveling Cranes, New York City.
Chloride of Silver Dry Cell Battery Co., Baltimore.
Christy Fire Clay Co., Fire Clay, St. Louis, Mo.
H. B. Claflin Co., Dry Goods, New York City.
Waldo M. Claflin, Shoes, Philadelphia, Pa.
H. A. Clarke & Co., New York City.
R. P. Clark & Co., Furniture, Washington, D. C.
Clark-Hutchinson Co., Shoes, New York City.
Charles H. Clayton, Publishers, New York City.
Clement & Stockwell, Paper, New York City.
James Clendenin, Zinc, Baltimore, Md.
The Cleveland Crane Engineering Co., Repair Parts, Wickliffe, Ohio.
Harry D. B. Clapp & Co., Wool Waste, Philadelphia.
Cleveland Faucet Co., Machinery, New York City.
Cleveland Pneumatic Tool Co., Pneumatic Tools, Cleveland, Ohio.
Cleveland Provision Co., Commissary Supplies, Cleveland, Ohio.
The Cleveland Punch & Shears Works, Punches, Cleveland, Ohio.
Cleveland Stamping & Tool Co., Tools, Cleveland, O.
The Cleveland Tool & Supply Co., Tools and Supplies, Cleveland, Ohio.
The Cleveland Twist Drill Co., Drills, Cleveland, O.
The Cleveland Varnish Co., Varnish, Cleveland Ohio
Cliff & Guibert Co., Hose Reels, New York City.
Cliff & Co., Oakum, New York City.
Climax Bearing Co., Detroit, Mich.
Climax Fuse Co., Fuse, New York City.

E. Clinton & Co., Brushes, Philadelphia, Pa.
Clinton Wire Cloth Co., Wire Netting, Clinton, Mass.
Clinton Wire Cloth Co., Wire Screens, N. Y. C.
Cliquot Club Co., Ginger Ale, Millus, Mass.
John Clochessy, Paper, New York City.
Clowes Shear Co., New York City.
James B. Clow & Sons, Plumbing, Chicago, Ill.
Cluett, Peabody Co., Collars, Cuffs & Shirts, N. Y.
Thomas E. Coale Lumber Co., Lumber, Philadelphia.
Coates Clipper Mfg. Co., Worcester, Mass.
Cobb Engrg. Co., Mach. Supplies, Boston, Mass.
Cockburn Barrow & Machine Co., Automatic Buckets, Jersey City, N. J.
Code, Porterwood Co., San Francisco, Cal.
E. P. K. Coffin, Stationery, New York City.
Coffin Valve Co., Valves, Neponset, Boston, Mass.
Cohen, Goldman Co., Clothing, New York City.
Colgate & Co., Talc. Powder & Soap, Jersey City, N. J.
Collins & Co., New York City.
Colombo Macaroni Factory, Macaroni, New Orleans.
Colonial Steel Co., Iron, Pittsburgh, Pa.
Columbia Chemical Co., Brooklyn, N. Y.
Columbia Incandescent Lamp Co., Incandescent Lamps, Carbon, St. Louis, Mo.
Columbia Facing Mills Co., Foundry Facings, Buffalo, N. Y.
Columbia Incandescent Lamp Co., N. Y. C.
Columbia School & Supply Co., Desks and Seats, Indianapolis, Ind.
Columbia Smelting & Refining Works, Zinc and Lead, New York City.
Columbian Rope Co., Manila Rope, Auburn, N. Y.
Columbus Chain Co., Hoisting Chains, Columbus, O.
Columbus Dist. Co., New York City.
Colwell Lead Co., New York City.
Combination Ladder Co., Hose Wagons, N. Y. C.
Combination Rubber Manufacturing Co., Hand Rubber Valves, Bloomfield, N. J.
Combination Rubber Co., New York City.
Commercial Acetylene Co., New York City.
Commonwealth Shoe & Leather Co., Shoes, Boston.
Compressed Air Machinery Co., Compressed Air Equipment, San Francisco, Cal.
Comyn, Mackall & Co., San Francisco, Cal.
Concrete Spade Manufacturing Co., Perforated Spades, Valparaiso, Ind.
C. B. Cones Co., Clothing, New York City.
Concrete Steel Co., Steel Reinforcement Bars, N. Y.
Geo. E. Conley, Commission Merchant, N. Y. C.
Conley Tin Foil Co., New York City.
Conron Bros., Packers, New York City.
Consolidated Eng. Strap Co., New York City.
Consolidated Safety Valve Co., Valves, N. Y. C.
Consolidated Sales Co., Steel Plates, Wash., D. C.
Consolidated Stamp Mfg. Co., Stamps, N. Y. C.
Consolidated Wafer Co., Brooklyn, N. Y.
Peter J. Constant, Brooms, Brooklyn, N. Y.
Consumers Flavoring Extract Co., Christmas Tree Ornaments, New York City.
Consumers Supply Co., Stationery, N. Y. C.
Continental Rubber Works, Suction Hose, N. Y. C.
Contractors Supply & Equipment Co., Concrete Mixers, New York City.
Adam Cook's Sons, Yellow Lubricating Grease, N.Y.
William P. Cook & Co., Cross Ties, N. Y. C.
Cook & Cokefair Co., Peerless Oil, New York City.
Peter Cooper's Glue Factory, Glue, etc., N. Y. C.
Raymond Copeland, Flour, New York City.
M. G. Copeland, Bunting, Washington, D. C.
Cooper-Hewitt Elec. Co., Tubes, New York City.
Corliss, Coon Co., Collars, New York City.
Corn Products Refining Co., Karo and Syrups, N. Y.
J. D. Cornell Co., Packers, New York City.
Cornelius Furniture Co., Furniture, Cornelius, N. C.
Cornell & Underhill, Wrought Iron Pipe, N. Y. C.
Corona Supply Co., Typewriter Supplies, Rochester, N. Y.
Corrugated Bar Co., Corrugated Steel Bars, Buffalo.
Cortland Skirt Co., Dry Goods, New York City.
Coston Signal Co., New York City.
H. T. Cottan & Co., Rice & Molasses, New Orleans.
Cowdrey & Co., Engine and Valve Oil, N. Y. C.
E. D. Cowell, New York City.
George Cowen, Window Glass, New York City.
L. D. Cramer, Stock Feed, New York City.
William Cramp & Sons Ship & Engine Building Co., Ships and Engines, Philadelphia, Pa.
The Crandall Packing Co., New York City.
Crandall Pettee Co., Baker's Supplies, N. Y. C.
Crane Co., Flanged Fittings, Plumbers Supplies, Chicago, Ill.
Crane Cooperage Co., New York City.
Herbert Crapster, Plumber's Supplies, N. Y. C.
William J. Crawford, Oils & Greases, Pittsburgh, Pa.
W. G. Creamer & Co., New York City.
J. W. Cregar Agency, Machines, Philadelphia, Pa.
Crerar, Adams Co., Trucks, Chicago, Ill.
Crescent Bed Co., New Orleans, La.
Crescent Cigar & Tobacco Co., Tob., New Orleans.
Cresca Co., Fruits, New York City.
George V. Cresson Co., Clutch Pulley, Philadelphia.
Crew Levick Co., Dynamos, Oil, Philadelphia, Pa.
Cronell & Matthews, Manhole Rings and Covers, Philadelphia, Pa.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Crouse-Hinds Co., Lighting Appar., Syracuse, N. Y.
Crouse-Hinds, Electrical Appliances, Syracuse, N.Y.
John A. Crowley & Co., Steel Material, N. Y. C.
Crown Suspender Co., Dry Goods, New York City.
Crown Oil & Wax Co., Engine Oil, Baltimore, Md.
Crown Ribbon Co., New York City.
The Crucible Steel Co. of America, New York City.
Crucible Steel Co. of America, Steel and Sheet Copper, Pittsburgh, Pa.
Crupples Adjustable Tooth Co., Steel Castings, Dipper Teeth, Tryon, Pa.
Crystal Lumber Co., Lumber, New Orleans, La.

Curtain Supply Co., New York City.
Curtice Bros., Groceries, Rochester, N. Y.
Curtiss & Blasdell, Coal, New York City.
The Cutler-Hammer Mfg. Co., Limit Switches, Milwaukee, Wis.
Cutlet Electric & Motor Co., Philadelphia, Pa.
Cuyler & Mohler, Galvanized Iron Pipe, Baltimore.
The Cyclone Drill Co., Drilling Machs., Orrville, O.
Cypress Incubator Co., New York City.

D

Dailey & Ivins, Sea-going Tugs, New York City.
Dairy Farm & Produce Co., Comsy. Sup., N. Y. C.
Dairy Mach. & Cont. Co., Machinery, Derby, Conn.
Dake Engine Co., Motor Hoists, Grand Haven, Mich.
H. T. Dakin, Paper Manufacturers, New York City.
F. E. Dalley & Co., Shoe Polish, Buffalo, N. Y.
James Dalzell Co., Pittsburgh, Pa.
John Damm & Sons Brush Mfg. Co., Brushes, St. Louis, Mo.
Danville Stove & Mfg. Co., Ranges, Danville, Pa.
Damon & Peet, Ptg. Presses and Sup., N. Y. C.
George Damon & Son, Ptg. Machinery, N. Y. C.
George F. Daniels & Co., Shoes, Boston, Mass.
Dann & Peckner, Wearing Apparel, New York City.
F. F. Dans & Co., Duplicating Machines, N. Y. C.
C. A. Danzenbaker, Asbestos Packing, Washington, D. C.
Ed Darby & Sons Co., Ltd., Lockers, Phila., Pa.
Darrah & Small, Door Mats, New York City.
John B. Dauchy, Linseed Oil, New York City.
Davenport Locomotive Works, Locomotives, Davenport, Ia.
George W. Davidson & Co., Unions, New Orleans.
Davis & Brandon, Piling, Jacksonville, Fla.
Davis-Bournonville Co., Machinery Welding and Cutting Apparatus, New York City.
The Davis Coke & Coal Co., Coke, Coal, N. Y. C.
H. B. Davis Co., Metallic Brown, Baltimore, Md.
J. H. Day, Hardware, Cincinnati, Ohio.
The Deane Steam Pump Co., Steam Pumps, N. Y. C.
Decker & Son, Inc., Piano Mfrs., New York City.
Defiance Lumber Co., Lumber, Tacoma, Wash.
De Gram, Aymar Co., New York City.
Lewis De Groff & Sons, Commissary Sup., N. Y. C.
P. Delany & Co., Mooring Buoys, Newburgh, N. Y.
Howard S. Delany, Reams, Cloth, Philadelphia, Pa.
De Laval Steam Turbine Co., Motor Pumps, Trenton, N. J.
The Delaware Marine Supply Co., Butts, Hinges, Wilmington, Del.
Del Monte Milling Co., Flour, San Francisco, Cal.
Edmond E. Delp & Co., Philadelphia, Pa.
Delpark Production Co., Ties, New York City.
Delphi Wagon Works, School Wagons, Delphi, Ind.
W. B. Deming, Railway Material, New York City.
Denman & Davis, Iron and Steel, New York City.
Dennison Manufacturing Co., Paper Goods, N. Y. C.
Densmore Typewriting Co., New York City.
Denzer, Goodhart & Schener, Wearing Ap., N. Y. C.
William Dermuth & Co., New York City.
Detroit Graphite Co., New York City.
Detroit Hoist & Machine Co., Detroit, Mich.
Detroit Leather Specialty Co., Inc., Leather, Detroit.
Detroit Lubricator Co., Detroit, Mich.
Detroit Steel Casting Co., New York City.
De Vane Mfg. Co., Hammer Handles, Brevard, N.C.
Deven Telephone Mfg. Co., New York City.
F. W. Devoe & C. T. Raynolds Co., Paints and Varnish, New York City.
Dexter Folding Co., Folding Machines, N. Y. C.
John A. Dialogue & Son, Propellers, Camden, N. J.
Diamond Ink Co., Paste, Milwaukee, Wis.
Diamond Rubber Co., New York City.
A. B. Dick & Co., Edison Mimeographs, Chicago, Ill.
Dickerson Vandusen & Co., Zinc Plates & Sheets, New York City.
Walter S. Dickey, Drain Tile, Fire Brick, Pipe, etc., Kansas City, Mo.
Walter S. Dickey, Vitrified Clay Duct, Kansas City.
Stewart Dickson & Co., Packing Asbestos, N. Y. C.
Diebold Safe & Lock Co., Vault Doors, N. Y. C.
Dietrich Bros., Steel, Baltimore, Md.
R. E. Dietz Co., Lanterns, New York City.
Dietz Engineering Co., Valves, New York City.
Eugene Dietzen Co., Blue Print Paper, N. Y. C.
L. L. Diggs & Co., Hatchets, Adzes, Scythes, N. Y. C.
Diggs Fire Extinguisher Co., New York City.
J. B. Dill & Co., Tobacco, Richmond, Va.
Dillworth, Gilbert & Towne & Co., N. Y. C.
Dillworth, Porter & Co., Track Spikes, Pittsburgh.
Dimmick Pipe Co., Pipe, Birmingham, Ala.
Hy Disston & Sons, New York City.
Joseph Dixon Crucible Co., Crucibles, Phila., Pa.
Dobler & Mudge, Canvas, Paper, Baltimore, Md.
Dodge & Alcott, Chemicals, New York City.
Dodge & Sweeney, Commissary Sup., San Francisco.
Dodge, Bliss Co., Lumber, Jersey City, N. J.
E. Doherty Rubber Works, Brooklyn, N. Y.
Jacob Dold Packing Co., Buffalo, N. Y.
J. F. W. Dorman & Co., Stationery, Baltimore, Md.
Double Service Packing Co., Philadelphia, Pa.
The John Douglas Co., Plumbing Sup., Wash., D. C.
J. Maury Dove Co., Coal, Washington, D. C.
Dover Boiler Works, Boilers, Dover, N. J.
Drake Standard Machine Works, Concrete Mixers, Chicago, Ill.
S. R. Dresher, Razors, New York City.
The Dressel Railway Lamp Works, Oil Cans, N. Y.
Drew Machinery Co., Carborundum Wheels, Manchester, N. H.
Dreyfous & Co., Ltd., Mosquito Bars, New Orleans.
Dreyer Hat Co., Hats, New York City.
Drouve & Co., Bridgeport, Conn.
M. J. Drummond & Co., Iron Pipe, N. Y. C.
Dry Milk Co., New York City.
James B. Drysdale, Chairs, New York City.
F. N. Du Bois & Co., Pipe Elbows, New York City.

B. P. Ducas Co., Chemicals, New York City.
Ducker Co., Sectional Building, New York City.
Richard Dudgeon, Jacks, New York City.
Duetsche Maschinenfabrik Actiengeselleschaft, of Duisburg, Germany, Two Floating Cranes.
P. Duff & Sons, Commissary Supplies, N. Y. C.
The Duff Mfg. Co., Loco. Jacks, Pittsburgh, Pa.
J. P. Duffy Co., Mason Supplies, New York City.
Dugan & Hudson, Shoes, Rochester, N. Y.
Duhrkop Oven Co., New York City.
Duluth Superior Milling Co., Duluth, Minn.
A. Dumser & Co., Cheese, New Orleans, La.
G. W. Dunbar Sons, Commission Merchant, New Orleans, La.
W. M. Duncan, Refrigerators, New York City.
J. H. Dunham & Co., Wearing Apparel, N. Y. C.
Dunlap Printing Co., Money Order Pads, Phila., Pa.
Duparquet Huot & Moneuse Co., Ranges, etc., Washington, D. C.
M. Du Perow, Copper Cable, Washington, D. C.
Duplex Roller Bushing Co., Blocks, Belfast, Maine.
E. I. Du Pont Powder Co., Wilmington, Del.
Duque & Co., Molasses, New Orleans, La.
N. C. Durie Co., Rubber Goods, St. Louis, Mo.
C. D. Durkee & Co., Marine Goods, New York City.
Durkee's Salad Dressing Co., New York City.
Dutchess Tool Co., Fishkill-on-Hudson, N. Y.
Duryea & Barwise, Coffee, New York City.
Charles W. Dwenger, New York City.
Dwyer Bros., Wearing Apparel, New Orleans, La.

E

Eagle Lock Co., Locks, New York City.
Eagle Pencil Co., Pencils, etc., New York City.
Eagle Rolling Mill Co., Flour, New Ulm, Minn.
Earle Brush Co., Columbia, Pa.
Earle & Wilson, Shirts, New York City.
Earle Gear & Machine Co., Philadelphia, Pa.
John Earlies Sons, Brooms, New York City.
Early & Daniel Co., Forage, Cincinnati, Ohio.
James N. Early, Kitchen Utensils, New York City.
Eastern Granite Roofing Co., Roofing, N. Y. C.
Eastman Kodak Co., Kodaks, Rochester, N. Y.
Perley R. Eaton, Lumber, Fitchburg, Mass.
Eckhart Milling Co., Flour, Chicago, Ill.
Eclipse Wood Pulley Co., Berlin, Pa.
Edison Mfg. Co., Electrical Supplies, N. Y. C.
E. J. Edmond Co., Auto Supplies, New York City.
Edna Brass Mfg. Co., Loco. Injectors, Cincinnati,O.
Eichold & Miller, New York City.
Einers & Amend, Testing Apparatus, N. Y. C.
Anthony Eisler & Co., Tape, New York City.
Ekenberg Milk Producing Co., New York City.
Electric Appliance Co., Molding, New Orleans, La.
Electric Controller & Manufacturing Co., Lifting Magnet, Philadelphia, Pa.
Electric Hose & Rubber Co., New York City.
Eldredge Baker & Co., Groceries, Boston, Mass.
Electro-Silicon Co., New York City.
G. Elias & Bros., Lumber, Buffalo, N. Y.
John Ellice & Co., Cotton Waste, New York City.
Ellicott Machine Corporation, Dredge, Baltimore.
Elliot Fisher Co., Machine Head and Repair Tools, Harrisburg, Pa.
Elliott Addressing Machine Co., New York City.
Elmer De Pue, Wines, New York City.
El Reno M. & E. Co., Flour, El Reno, Okla.
Ely & Williams, Iron & Steel, New York City.
Emerson Steam Pump Co., Pumps, Alexandria, Va.
Emmelmann Bros, Mfg. Co., Blow Torch, Indianapolis, Ind.
G. C. Engel, Meats, New York City.
Engleberg & Waidman Co., Box Mfrs., New York
The Ensign Lumber Co., Lumber, Jacksonville, Fla.
Epping-Carpenter Co., Water Cylinders, Pittsburgh.
Equitable Supply Co., Machinery, N. Y. C.
Erlanger Bros, Wearing Apparel, New York City.
Escola Supply Co., New York City.
Esterbrook Steel Pen Co., Pens, Stationery, N. Y. C.
Eureka Fire Hose Co., Cotton Hose, Pipe, N. Y. C.
Eureka Rubbing Stone Co., Chicago, Ill.
Eureka Vibrator Co., New York City.
Evans & Howard Fire Brick Co., Fire Clay & Brick and Pipe, St. Louis, Mo.
Richard Evans, New York City.
S. F. Everett, Cleveland, Ohio.
Everett Mfg. Co., Dump Wagons, Newark, N. J.
Excello Arc Lamp Co., Arc Lamps, New York City.
Excelsior Equipment Co., Pneumatic Equipment, Coil Chain, Dippers, Pittsburgh, Pa.
Excelsior Tool & Machine Co., Iron and Steel, E. St. Louis, Mo.
Excelsior Varnish Co., Paints and Varnish, N. Y. C.
Export Electric Supply Co., Electrical Sup. N.Y.C.
Export Lumber Co., Lumber, New York City.

F

Eberhard Faber Co., Pencils, Brooklyn, N. Y.
J. Faessler Manufacturing Co., Moberly, Mo.
N. K. Fairbanks, Gold Dust Washing Pow., Chicago.
N. K. Fairbanks Co., Gold Dust Washing Pow., N. Y.
The Fairbanks Co., Steel Shafting, Couplings, etc., New York City.
Fairbanks, Morse & Co., Hand and Push Cars, Inspection Motor Cars, Chicago, Ill.
Fairbanks Scales Co., Hardware, New York City.
The Fairest Steel Co., Springs, Bridgeport, Conn.
Fairmont Coal Co., Coal, New York City.
Joseph Faltermayer, Washers, Wrought Cut, Philadelphia, Pa.
James H. Fanchoner, Dairy Supplies, N. Y. C.
A. D. Farmer & Son Type Founding Co., Type, N. Y.
J. A. Fay & Eagan Co., Boring Machs., Cincinnati,O.
J. A. Fay & Egan Co., Woodworking Machy. N.Y.C.
Fred Fear & Co., Fish & Oysters, New York City.
Fearless Dishwasher Co., Fearless Dishwashers, N.Y.

Federal Clay Products, Pittsburgh, Pa.
Federal Co., Hospital Sinks and Plumbing, Chicago.
M. Feigel & Bro., Chemicals, Paints and Oils, New York City.
Felt & Tarrant Mfg. Co., Comptometers, Chicago.
August Ferger & Co., Feed, Cincinnati, Ohio.
F. Ferguson & Son, Transfer Agents, N. Y. C.
Joseph V. Ferguson, Straw, New Orleans, La.
F. A. Ferris & Co., Meat, New York City.
The Fibre Conduit Co., Socket Joints, Orangeburg, N. Y.
W. R. Ficke Co., Stationery, New York City.
Fidaque & Co., Shoes, Brooklyn, N. Y.
Marshall Field & Co., Dry Goods, Chicago, Ill.
E. Fincken & Co., Coal, New York City.
Findlay, Dicks & Co., Drug Sup., New Orleans, La.
Fireproof Furniture & Construction Co., N. Y. C.
Fischer Bros., Show Cases, New York City.
J.&C. Fischer, Piano Manufactuers, New York City.
Fiske Bros., Refrigerating Co., New York City.
Fiske Bros. Refining Co., Oil and Lubricating Grease, New York City.
Flaccus E. C. & Co., Spices, Wheeling, West Va
The Flash Chemical Co., Cleanser, Boston, Mass.
Flecke Bros. & Co., Bends, Philadelphia, Pa.
D. B. Fleming & Co., Leather Supplies, New York.
George C. Flint Co., Mattresses, New York City.
Flint & Chester, Ry. and Cont. Supplies, N. Y. C.
Florence Brush Mfg. Co., Brushes, New York City.
Florsheim Shoe Co., Shoes, Chicago, Ill.
J. H. Flynn, Jr., New York City.
Focht Iron Works, Iron and Steel, Hoboken, N. J.
George Fochten Sons, Hoboken, N. J.
R. R. Fogel & Co., Novelties and Jewelry, N. Y. C.
Follmer Clogg Co., Umbrellas, New York City.
H. & D. Folson Arms Co., Clay Pigeons, New York.
Foote Burt Co., Machinery Designs, Cleveland, O.
The Forbes Co., Sterilizers, Philadelphia, Pa.
John Forbes, Paper, New York City.
F. Codman Ford, New Orleans, La.
Forester Mfg. Co., Toothpicks, Dixfield, Me.
Fort Pitt Forge Co., Pittsburgh, Pa.
Fort Pitt Malleable Iron Co., Drill Sill Caps, Pittsburgh, Pa.
Foster Engineering Co., Valves, Newark, N. J.
Foster Pump Co., Pumps, New York City.
Foster Valve Co., Valves, Newark, N. J.
Julius Fowl, Hampers, New York City.
Fox Bros. & Co., Hand Cars, etc., New York City.
M. Ewing Fox Co., Muralite, New York City.
Fox River Butter Co., Butter, New York City.
Franklin Manufacturing Co., Franklin, Pa.
Julien P. Friez, Ram Gauges, Ink, Forms, Baltimore.
Frog Switch & Signal Co., Ry. Equip., Carlisle, Pa.
Franco-American Food Co., Canned Goods, Jersey City, N. J.
Henry Frank, Leather, New York City.
Henry Frank, Jr., General Supplies, New York City.
L. Frank & Co., Fruits & Vegetables, New Orleans.
Frankel Display Fixture Co., New York City.
Franklin McVeagh & Co., Chicago, Ill.
Franklin Portable Crane & Hoist Co., Portable Cranes, Franklin, Pa.
P. A. Frasse & Co., Machinists' Supplies, N. Y. C.
H. J. Freeman, Mattresses, New York City.
Freidman-Shelby Shoe Co., Shoes, St. Louis, Mo.
Frevert Machinery Co., Blocks, New York City.
Froment & Co., Pipe Line and Dredges, N. Y. C.
Fuchs & Lang Manufacturing Co., New York City.
Fuerst Bros. & Co., Carbolic Acids, New York City.
Fuller Bros. & Co., General Supplies, New York City
Fullerton Case Co., New York City.
Fulton Bag & Cotton Mills, New York City.
Fulton & Walker Co., Philadelphia, Pa.

G

John S. Gage, Dry Goods, New York City.
Gaine Bros., Book Binders, New York City.
Galena-Signal Oil Co., Car, Eng. & Valve Oil, N. Y.
The Gamewell Fire-Alarm Telegraph Co., Automatic Fire Alarms, New York City.
Gardner Governor Co., Cylinders and Hardware, Quincy, Ill.
Garlock Packing Co., New York City.
Thomas Garner & Co., Stationery, New York City.
John Garrie & Sons, Inc., Produce Merchant, N.Y.C.
The Garvin Machine Co., Drill Presses, N. Y. C.
Gas Engine & Power Co., Launch, New York City. Charles L. Seabury & Co., New York City.
Gates City Filter Co., New York City.
R. H. Geldart, Wrenches, Reamers, Oakum, N. Y. C.
General Chemical Co., Sulphate of Alumina, N. Y.C.
Gen. Elec. Co., Switch & Gage Boards & Accessories, Schenectady, N. Y.
The General Fireproofing Co., Bookcase Sections, Washington, D. C.
General Fireproofing Co., Draughting Tables and Filing Cases, Youngstown, Ohio.
General Railway Signal Co., Signal Supplies, N.Y.C.
Genessee Pure Food Co., Le Roy, N. Y.
Gerry & Murray, Office Sup., Printers, N. Y. C.
F. W. Gesswein, Tools, New York City.
Getz Bros., San Francisco, Cal.
Gibson Bros., Tabular Code, Washington, D. C.
Robert Gilchrist & Co., Ferromanganese, Elizabethport, N. J.
E. B. Gill Mfg. Co., Hangers, Chicago, Ill.
William D. Gill & Co., Lumber, Baltimore, Md.
Gillette Sales Co., Razors, Boston, Mass.
D. L. Gillispie Co., Lumber, Pittsburgh, Pa.
I. Gilman & Co., Manila Paper, New York City.
Gimbel Bros., Dry Goods, New York City.
Ellis A. Gimbel, Beds, Philadelphia, Pa.
Ginsberg & Dubersteins, Hats, New York City.
Glauber Brass Mfg. Co., Clocks, Cleveland, Ohio.
Glacier Metal Co., Anti-friction Metal, Richmond, Va.
V. Glad & Sons, Ranges, Philadelphia, Pa.

William Gleichman, Flour, Brooklyn, N. Y.
Globe-Wernicke Co., Office Supplies, N. Y. C.
Glogua & Co., Alcohol Stoves, Chicago, Ill.
G. A. Gobel, Wearing Apparel, Chicago, Ill.
J. Gockner, New York City.
Frank Godley Co., Extracts and Flavoring, N. Y. C.
Goez Optical Co., New York City.
Gold Medal Camp Furniture Co., Cots, Racine Junction, Wis.
C. H. & E. S. Goldberg, Woodware, N. Y. C.
Golden-Anderson Valve Specialty Co., Safety Valves, Pittsburgh, Pa.
Goldschmidt Thermit Co., Thermit Welds, N. Y. C.
Goldschmidt & Co., Dresses, New York City.
L. & M. Goldsticker, Bottlers' Supplies, N. Y. C.
Goodell Pratt Co., Tools, Greenfield, Mass.
E. H. Goodman, New York City.
H. Goodman Co., Eggs, New Orleans, La.
The B. F. Goodrich Co., Belting, Akron, Ohio.
B. F. Goodrich Co., Rubber Goods, N. Y. C.
Goodwin Car Co., Cars, New York City.
George C. Goodwin, New York City.
Nelson Goodyear, Buoys, Lanterns, New York City.
Goodyear Rubber Co., Rubber Coats, N. Y. C.
H. R. Gordon Co., Sugar, New York City.
W. A. Gorden Co., Fish, New Orleans, La.
Gorham Mfg. Co., Sterling Silverware, Providence.
Goshen Mfg. Co., Oleomargarine, Providence, R. I.
H. T. Gottam & Co., New Orleans, La.
Gotz Bros., San Francisco, Cal.
Gould Coupler Co., New York City.
W. R. Grace Co., Lumber, New York City.
Graft Morsbach & Co., Harness, New York City.
A. D. Granger Co., Power Plant Machinery, New York City.
Grand Rapids Show Case Co., New York City.
Grand Rapids Refrigerator Co., Refrigerators, N. Y.
The Granite Railway & Signal Co., Pittsburgh, Pa.
N. Z. Graves Co., Paints, New York City.
N. Z. Graves, Co., Paints and Varnish, Phila., Pa.
Peter Gray & Sons, Cambridge, Conn.
William S. Gray & Co., Chemicals, New York City.
Great Eastern Clay Co., New York City.
Great Western Cereal Co., Chicago, Ill.
Greenlee Bros. & Co., Wood Working Machinery and Tools, Rockford, Ill.
A. W. Greely, Shoes, Haverhill, Mass.
Henry J. Green, Scientific Instruments, N. Y. C.
W. Green & Co., Plain Rivet Lathe, New York City.
Greensboro Table Co., Tables, Greensboro, N. C.
Greenfield's Candy Co., New York City.
Gress, Owens & Co., Drugs, New York City.
John Grieg, Chemicals, New York City.
Griffin Manufacturing Co., Polish, New York City.
Griffing Wheel Co., Cast Iron Wheels, Wash., D. C.
The Griscom-Spencer Co., Wrought Iron Black Pipe, New York City.
The Groton-Pew Fish Co., Gloucester, Mass.
Gude Bros. & Kieffer, Creamery, New York City.
Guggenheim Food Co., San Francisco, Cal.
Gulfport Creosoting Co., Piles, Guard Rails, Creosoted Ties, Gulfport, Miss.
A. Gunnison & Co., Creosote Oil, New York City.
W. & L. E. Gurley, Repair Parts for Current Meters, Bi-Sulphate Mercury Batteries, Troy, N. Y.
C. Gutman & Co., Suits, New York City.
The Gutta Percha & Rubber Mfg. Co., Hose, N.Y.C.

H

Haas Bros., Sweetmeats, San Francisco, Cal.
C. H. Haddley, Groceries, Champaign, Ill.
William W. Haff, Coal, New York City.
A. L. Hagan Co., Laundry Plant, Ancon Hospital, Philadelphia, Pa.
Haggerty Bros., Glassware, New York City.
Haines, Jones & Cattlebury Co., Philadelphia, Pa.
Alva Hall Co., Umbrellas, New York City.
Frank A. Hall, Pillows, New York City.
Hall Switch & Signal Co., New York City.
Hall & Brown Wood Working Machine Co., Moulding Machines, St. Louis, Mo.
Hall & Ruckel, Tooth Wash, New York City.
George C. Hale, Fire Hose Truck, Kansas City, Mo.
Hale Co., Furniture, New York City.
Hale Desk Co., New York City.
Hale & Kilburn Mfg. Co., Wrought Metal Wk., N.Y.
Hallidie Machinery Co., Drill Presses and Lathes, Seattle, Wash.
Felix Hamburger, Computing Machines, N. Y. C.
The Hamilton Co., Portable Houses, N. Y. C.
Hamilton Brown Co., Shoes, St. Louis, Mo.
The Hamilton-Low Co., Dish Washing Mach., N. Y.
Hamilton Rubber Mfg. Co., Trenton, N. J.
Hamilton Co., Railway Supplies, New York City.
Hammacher, Schlemmer & Co., Hardware, N. Y. C.
Hammer Bros. White Lead Co., E. St. Louis, Mo.
Hammond Typewriter Co., New York City.
Hanan & Son, Shoes, Brooklyn, N. Y.
The Hancock Inspirator Co., New York City.
Handlan-Buck Mfg. Co., Elbows, Belting, Powder, Pipe Cutter, etc., St. Louis, Mo.
Joshua Handy Iron Works, San Francisco, Cal.
Handy Rule & Level Co., New York City.
P. Hano & Co., Books, New York City.
William S. Hansall & Sons, Philadelphia, Pa.
Ferdinand Hansen, Green Cups, New York City.
Harbeson Textile Co., New York City.
Harbison-Walker Refractories Co., Fire Bricks, Pittsburgh, Pa.
Harland & Hollingsworth Corporation, Boilers, Wilmington, Del.
P. J. Harney Shoe Co., Shoes, New York City.
Harney Shoe Co., Footwear, Lynn, Mass.
The Harral Soap Co., Laundry Soap, N. Y. C.
Harrick Manufacturing Co., Forges, N. Y. C.
Harries, Jones & Cadbury Co., Plumbing Supplies, Philadelphia, Pa.
Jacob Harris, Clothing, Rubber Goods, N. Y. C.

F. Harris, Chicago, Ill.
William B. Harris Co., Coffee, N. Y. City.
Harris Suspender Co., New York City.
Harrison Bros. & Co., Manf. Paints & Varnishes, New York City.
Harrison Supply Co., Lighting Material, N. Y. C.
Harry Bros. Mfg. Co., New Orleans, La.
Hart, Schafner & Marx, Wearing Apparel, N. Y. C.
Louis Hartig, Paddocks, Piles, Washington, D. C.
Hartford Machine Screw Co., Hartford, Conn.
M. Hartley Co., New York City.
Hasbey & Mattson, New York City.
L. C. Hasinger Co., Sledge Handles, Indiana, Pa.
E. C. Hausberg, New York City.
Havana Tobacco Co., New York City.
Haverside, Withers & Davis Co., Gear Wheels, San Francisco, Cal.
Hawes, Vol. Gal., Men's Hats, New York City.
Hawley Box Co., New York City.
The Hayden & Derby Mfg. Co., Injectors, N. Y. C.
Hayden-Corbett Chain Co., New York City.
R. S. Hayes, Switches, Carlisle, Pa.
Hayes Track Appliance Co., New York City.
The Haywood Co., Dredges, New York City.
E. C. Hazard & Co., Groceries, New York City.
Hazard Mfg. Co., Wire Rope, Wilkesbarre, Pa.
Headley & Farmer, Leather Goods, New York City.
D. S. Heath & Co., Books, Boston, Mass.
Heath & Milligan Mfg. Co., Paint, Chicago, Ill.
Hecker, Jones & Jewell Co., Flour, New York City.
Heeler Bros. Co., Newark, N. J.
Hegeman & Co., Druggists, New York City.
Heinz Pickle Co., Spices, Pittsburgh, Pa.
Heller & Brightly, Engineering and other Instruments, Philadelphia, Pa.
The L. Helmuth Co., New York City.
Helvetia Condensed Milk Co., New York City.
Hemmenway & Son, Flags, New York City.
A. J. Hemphill, New York City.
Peter Henderson & Co., Seeds, New York City.
Hendricks & Class, Hardware, New York City.
E. L. Henter, San Francisco, Cal.
Joseph M. Herman, Shoes, Boston, Mass.
Herman, Bahr & Co., New York City.
Herpicide Co., Hair Tonic, Detroit, Mich.
Herring, Hall, Marvin Safe Co., New York City.
Herron Pump & Foundry Co., Valves & Hydrants, Chattanooga, Tenn.
Hersey Mfg. Co., Water Meter, S. Boston, Mass.
E. L. D. Hester Co., Refrigerators, New York City.
G. B. Hewlett, Drawing Materials, New York City.
Hewitt Rubber Co., Air Brake Hose, Buffalo, N. Y.
Heywood Bros. & Wakefield, Furniture, N. Y. C.
Hibbard, Spencer, Bartlette & Co., White Zinc, Tools and Supplies, Chicago, Ill.
W. O. Hickok Mfg. Co., Paper Ruling Machines, Harrisburgh, Pa.
Hicks-Hampton Lumber Co., Lum., San Francisco.
W. A. Higgins Packing Co., New York City.
Higgins & Seiter, Chinaware, New York City.
Hildreth & Segelken, Honey, New York City.
The Hill Clutch Co., Clutch Rope Sheaves, Cleveland, Ohio.
Alfred Hiller Co., Ltd., Acid, Oil, beeswax, New Orleans, La.
Hillery, Kelly Co., Eggs, New Orleans, La.
Hills Bros., Fruit Importers, New York City.
Hillis & Jones Co., Washer-cutting Machine, Wilmington, Del.
Thomas H. Hindle, Typewriter Supplies, N. Y. C.
Hindley Mfg. Co., Steel, Valley Falls, R. I.
Edward Hines Lumber Co., White Pine Lumber, Chicago, Ill.
Hinton-White Co., New Orleans, La.
Leon Hirsh & Son, Sal Soda, Chalk, Resin, Chloride of Lime, New York City.
Hirsch Lumber Co., Lumber, New York City.
Henry A. Hitner's Sons Co., Washers, Phila., Pa.
Clinton E. Hobbs, Chain Hoist, Boston, Mass.
Hodgman Rubber Co., New York City.
T. P. Hoffman & Co., Packing Excelsior, N. Y. C.
R. C. Hoffman & Co., Iron & Steel Goods, Baltimore.
Hoffman-Corr, Twine, New York City.
The Hoge & McDowell Co., Oats, Washington, D. C.
Hohlfeld Mfg. Co., Hammocks, Philadelphia, Pa.
Hohman & Maurer Mfg. Co., Thermometers, Rochester, N. Y.
J. Hohn & Sons, Commission Merchant, N. Y. C.
James Hohnham & Co., Wearing Apparel, N. Y. C.
Holt & Co., Flour, New York City.
Holton & Adams, Brushes, New York City.
The Holbrook Mfg. Co., Soap, Jersey City, N. J.
Holbrook Bros., Window Glass, New York City.
Holcomb Steel Co., Steel, Syracuse, N. Y.
Holloplane Co., Electrical Supplies, New York City.
Holstead & Co., Commission Merchant, N. Y. C.
Holzapfel's Amer. Composition Co., New York City.
Home Rubber Co., Rubber Hose, etc., Trenton, N. J.
Hooper & Jennings, Groceries, San Francisco, Cal.
Hoopes & Townsend Co., Nuts, Philadelphia, Pa.
Hopkins & Co., Wire Goods, New York City.
Herbert J. Horan, Flour, Philadelphia, Pa.
W. O. Horn & Bros., New York City.
Horsburgh & Scott Co., Gear Wheels, Cleveland, O.
Horton's Ice Cream, New York City.
Hospital Supply Co., Hospital Equipment, N. Y. C.
M. M. Hough, New York City.
Albert Houtman, Dry Goods, New York City.
Howard & Morse, Wire Goods, Brooklyn, N. Y.
Howe Comb Co., New York City.
Howe Scale Co., New York City.
B. H. Howell, Son & Co., Sugar, New York City.
Edwin C. Howell, Maps, Washington D. C.
Hoyt & Co., Drugs, Tooth Wash, Lowell, Mass.
Hubbard Portable Oven Co., Ovens, New York City.
Hubbard & Co., Shovels, Chisels, Picks, etc., Pittsburgh, Pa.
T. C. Hublein, Wholesale Liquor Dealer, N. Y. C.
R. Hudnut, Drugs and Perfume, New York City.
Hudson Oil & Supply Co., New York City.

Hulse Bros. & Daniels Co., Umbrellas, New York C.
R. A. Humphrey's Sons, Philadelphia, Pa.
U. T. Hungerford Brass & Copper Co., Chicago, Ill.
U. T. Hungerford Brass & Copper Co., New York C.
William Hunrath, Hardware, New York City.
Hunt Constn. Co., Coal Handling Machinery, N. Y.
Samuel E. Hunter, Produce, New York City.
S. E. Hunter, Popcorn, New York City.
Hunter & Trimm, Fish, New York City.
Hunter Milling Co., Wellington, Kans.
Huntoon Spring Water Co., New York City.
E. D. Hurlburt, Jr., Stationery, New York City.
C. C. Hussey, Copper, Pittsburgh, Pa.
Hutchinson Bros., Ranges, Baltimore, Md.
Hutchinson-Pierce Co., Wearing Apparel, N. Y. C.
Huyler Co., Candy, New York City.
Charles Hvass & Co., Brooms, New York City.
J. H. Hyde, Piles, Jacksonville, Fla.
Hyde Windlass Co., Steam Windlass, Bath, Maine.
Hydrex Felt & Engineering Co., Hydrex Felt,N.Y.C.

I

Ice & Cold Machinery Co., Refrigerating Machines, St. Louis, Mo.
A. L. Ide & Son, Engines for Dredges, Springfield, Ill.
John Illingsworth Steel Co., New York City.
Illinois Electric Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Independent Baking Powder Co., Jersey City, N. J.
Independent Electric Supply Co., New York City.
Independent Pneumatic Tool Co., Chicago, Ill.
Independent Pneumatic Tube Co., Riveting Hammers, Chicago, Ill.
Independent Refiners Sales Co., Lard Oil, N. Y. C.
Independent Salt Co., Brooklyn, N. Y.
Indiana Mfg. Co., Refrigerators, Peru, Ind.
Industrial Works, Loco. Cranes, etc., Bay City,Mich.
Horace Ingersoll Co., New York City.
Ingersoll-Rand Co., Pneumatic Drills, N. Y. C.
R. H. Ingersoll, Watches, New York City.
F. F. Ingram, Druggists, Detroit, Mich.
Inland Type Foundry, St. Louis, Mo.
Interborough Supply Co., New York City.
Interlaken Mills, Paper, Providence, R. I.
Inter-Ocean Steel Co., Tires, Chicago Heights, Ill.
International Elec. & Engrg. Co., New York City.
Interstate Electric Co., New Orleans, La.
International Electric Protection Co., Automatic Fire Alarms, New York City.
International Engineering Works, Boston, Mass.
International Filter Co., Paper, Chicago, Ill.
International Silver Co., New York City.
International Steam Pump Co., Pumps, N. Y. C.
Inter Seal & Lock Co., Hastings, Mich.
The Interstate Iron & Steel Co., Refined Iron, Chicago, Ill.
Interwoven Stocking Co., New Brunswick, N. J.
W. R. Irby Co., Tobacco, New Orleans, La.
W. F. Irish Electric Co., New York City.
Iroquois China Co., Syracuse, N. Y.
Iron City Tool Works, Ltd., Pittsburgh, Pa.
Irving Pitt Mfg. Co., Kansas City, Mo.
I. Isaac & Co., Ties, New York City.
Adolph Issacson & Son, Plumbers, New York City.

J

Jaburg Bros., Bakers' Supplies, New York City.
Jackson & Sharpe Plant of the American Car Foundry Co., Wilmington, Del.
Jackson Manufacturing Co., New York City.
Jacob Candy Co., New Orleans, La.
Henry B. Jacobs, Shoes, New York City.
Jacques Baszanger & Co., Carbons, New York City.
Dr. Jaegers Sanitary Woolen Systems Co., Wearing Apparel, New York City.
Jaenecke Printing Ink Co., New York City.
James Supply, Soldering Pipe, Chattanooga, Tenn.
Janesville Iron Works, Compressed Air Equipment, Janesville, Wis.
Walter Janvier, Soaps, New York City.
Jarecki Manufacturing Co., Pipe, Erie, Pa.
The Jeffery Mfg. Co., Belt Conveyors, Columbus,O.
Jenkins Bros., Valves Packing, New York City.
Jenkins Coal Company, New York City.
Jocknsch, Davidson & Co., Galveston, Tex.
H. W. Johns-Manville Co., Elec. Asbestos, N.Y.C.
Isaac G. Johnson & Co., Inc., Steel Castings, Spuyten Duyvil, N. Y.
Johnson Bros., Coal, Washington, D. C.
George R. Johnson, Dipper Handles, Baltimore, Md.
Johnson Wrecking Frog Co., Cleveland Ohio.
Mr. J. K. Joice, Lumber, Chicago, Ill.
Jones & Lamson Machine Co., Springfield, Vt.
Jones & Laughlin, Steel Co., Pittsburgh, Pa.
Henry E. Jones, Paper, New York City.
Jones Superior Machine Co., Saw Blades, Chicago.
O. F. Jordan Co., Earth Spreaders, Chicago, Ill.
John P. Jube & Co., Carriage Hardware, N. Y. C.
Juda Bros., Dry Goods, New York City.

K

Kaheival Co., Cigarettes, New York City.
David Kahnweiler Sons, Life Saving Appliances, New York City.
David Kahnuclers Sons, New York City.
Kalamazoo Corset Co., Kalamazoo, Mich.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
John P. Kane Co., Masons' Materials, N. Y. C.
L. Katzenstein & Co., Packing, New York City.
Kaufman Flonacher & Co., Suits, New Orleans, La.
The Kay & Ess Co., Ochre, Dayton, Ohio.
The Kay-Scheerer Co., Sterilizing and Disinfectant Apparatus, New York City.
Robert A. Keasby & Co., Asbestos, New York City.

Keasby & Mattison Co., Cement, Asbestos and Felt Goods, Ambler, Pa. and New York City.
E. F. Keating Co., Pipe, New York City.
E. Keeler Co., Boilers, Williamsport, Pa.
Charles A. Keene, Jewelry, New York City.
Keep Mfg. Co., Wearing Apparel, New York City.
Keiffer Bros. Shoe Co., New Orleans, La.
Kellner Bros., Furniture, New York City.
The M. W. Kellogg Co., Pipe & Chimneys, N. Y. C.
T. P. Kelly & Co., Foundry Supplies, N. Y. C.
Martin Kelly, Commission Merchant, New York.
Kelly-Springfield Motor Truck Co., Motor Busses, Springfield, Ohio.
Kelly-Springfield Road Roller Co., Springfield, O.
Kemicott Co., Water Weigher, Chicago, Ill.
Kemp, Day & Co., Groceries, New York City.
Kemp Machinery Co., Baltimore, Md.
J. B. Kendall & Co., Iron & Steel, Wash., D. C.
The Kendall Coal Mining Co., Cleveland, Ohio.
The Kennedy Valve Mfg. Co., Elmyra, N. Y.
Robert A. Kensbury Co., Handhole Caskets, N. Y. C.
Kensington Engine Works, Ltd., Philadelphia, Pa.
P. Kent Co., Burlap Bags, New York City.
Kentucky Wagon Mfg. Co., Louisville, Ky.
Kenworthy Engrg. Co., Furnaces, Waterbury, Conn.
C. Kenyon Co., Raincoats, Brooklyn, N. Y.
Thomas G. Keogh, Vacuum Gauges, N. Y. C.
Kerite Insulated Wire & Cable Co., Wire Cables, N.Y.
J. R. Keiser, Ties, New York City.
Keystone Blue Paper Co., Philadelphia, Pa.
Keystone Driller Co., Beaver Falls, Pa.
Keystone Lubricating Co., Philadelphia, Pa.
Keystone National Powder Co., Powder, N. Y. C.
King Keystone Oil Co., San Francisco, Cal.
The Keystone Type Foundry Co., Philadelphia, Pa.
Keystone Watch Case Co., Philadelphia, Pa.
Kilbourne & Jacobs Mfg. Co., Hand Carts, Columbus, Ohio.
Kilbourne & Jacobs, Tires, Rubber, N. Y. C.
Kilby Frog & Switch Co., Birmingham, Ala.
C. P. Kimball & Co., Half-top Cabriolets, Chicago.
Kingan Provision Co., New York City.
Kipp Wagon Works, New York City.
H. B. Kirkham & Son, Sawdust, New York City.
Kittoe Boiler & Tank Co., Canton, Ohio.
Henry Klein, Chemists, New York City.
Kleinert Rubber Co., New York City.
Knickerbocker Ice Co., New York City.
Knickerbocker Mills Co., Commissary Sup. N. Y. C.
C. C. Knight Co., Steel Plates, Philadelphia, Pa.
Knothe Bros., Leather Goods, New York City.
Knox & Bro., Hammers, Wrenches & Punches, N. Y.
Koelsch Bros., Butchers, New York City.
Kohlman Bros. & Sugaman, Fruits, New Orleans, La.
H. Kohnstann, Laundry Supplies, New York City.
Herman Kohn, Wearing Apparel, New York City.
Kohn, Weil & Co., Hats, New Orleans, La.
Kosy Slipper Co., Lynn, Mass.
A. S. Kottwitz Co., Eggs, New Orleans, La.
William Kraft, New York City.
Krag Imperial Cabinet Co., Washington, D. C.
Charles A. Kreig, Shoe Laces, New York City.
Krengel Manufacturing Co., Stamps, N. Y. C.
Kuffon & Demerest, Hardware, New York City.
Kurtz & Co., Commissary Supplies, Ohio, Ill.

L

Laclede-Christy Clay Products Co., Blocks, Tiling, St. Louis, Mo.
E. R. Ladew, Leather & Hides, New York City.
The Laidlaw-Dunn-Gordon Co., Air Compressors and Receivers, New York City.
Laidlaw-Dunn-Gordon Co., Fly Wheels, Compressor, Cincinnati, Ohio.
Lake Bros., Umbrellas, New Orleans, La.
Lambert Hoisting Engine Co., Newark, N. J.
Lambert Pharmacy Co., Philadelphia, Pa.
Lambert's Point Tow Boat Co., Norfolk, Va.
Lamont & Corliss Co., Cocoa and Chocolates, New York City.
Lamsen Com. Stores, Commissary Supplies, New York City.
Lamson Cash Carrier Pneumatic Tube Co., N. Y. C.
Lancaster Forge & Blower Co., New York City.
Henry W. Landen, Chemicals, Newark, N. J.
Landers, Frary & Clark, Hardware, New York City.
Landis Sewing Machine Co., New York City.
Landis Tool Co., Waynesboro, Pa.
W. T. Lane & Bros., Hardware, Poughkeepsie, N. Y.
J. H. Lane & Co., Commission Merchants, N. Y. C.
Lane & De Groot Co., Launches, Life Rafts, N. Y. C.
L. Langsdorf & Co., Stationery, Minors, N. Y. C.
Lanman & Kemp, Druggists, New York City.
W. K. Lanman, Machine Bolts & Nuts, Columbus, O.
Julius Lansburgh Furniture & Car. Co., Wash. D. C.
Lansing Wheelbarrow Co., Wheelbarrows, N. Y. C.
The Lanston Monotype Mach. Co., Philadelphia, Pa.
J. K. Larkin & Co., Washers, Nuts, etc., N. Y. C.
E. B. Latham & Co., New York City.
W. J. Lathan & Sons, Agents Produce Exchange Annex, New York City.
Laughead & Co., Menu Cards, Philadelphia, Pa.
Launto New Bedford Copper Co., New Bedford, Mass.
Laux & Appel, Fruit & Vegetables, New Orleans, La.
O. C. Lawrence & Co., Stationers, New York City.
H. T. Lawler & Son, Grain, New Orleans, La.
Lawyers Co-operative Publishing Co., Rochester.
S. C. Laylor Chain Co., Chicago, Ill.
Leadite Co., Leadite, Philadelphia, Pa.
Lead Products Co., St. Louis, Mo.
Lebanon Chain Works & Iron Co., Lebanon, Pa.
W. H. Lear, Lumber, Philadelphia, Pa.
Lebdejeff & Co., New York City.
The Leeds & Northup Co., Galvanometers, Phila., Pa.
William A. Leggett Co., New York City.
B. Legrade, Tobacco, New York City.
Lehigh-Portland Cement Co., Allentown, Pa.

Isaac Lehmann, New York City.
Lehn & Fink, Druggists, New York City.
Leibig Extract Co., New York City.
John P. Lein & Sons, Berths for laborers' quarters, New York City.
Leob Bros. Leather Belting Co., New York City.
J. H. Leonard & Co., Brass Brushings, Unions, etc., New York City.
Leousi Clonney & Co., Sponges, New York City.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lestrade Bros., Dairy, New York City.
Leuher Engineering Co., New York City.
Levy Bros., Wearing Apparel, Louisville, Ky.
The B. Levy Co., Wholesale Druggists., Boston.
C. Levy's Sons, Hats, New York City.
Bernard Levy, Wearing Apparel, New York City.
Lewine Bros., Neckwear, New York City.
H. Lewis & Co., Ltd., New Orleans, La.
S. W. Lewis & Co., Fish for Export, New York City.
H. K. Lewis & Co., Railroad Track, New Orleans.
Libbey, McNeil & Libbey, Meat Packers, Chicago.
Liberty Oil Co., Kerosene, New Orleans, La.
Library Bureau, Cabinets, Washington, D. C.
Lidgerwood Mfg. Co., Hoisting Engineers, N. Y. C.
Liebers Code Co., Book Store, New York City.
A. S. Liebovitz & Co., New York City.
S. Liebovitz & Son, Clothing, New York City.
Lignum Chemical Works, Brooklyn, N. Y.
Dexter P. Lillie & Co., Waste, Chicago, Ill.
J. E. Linde Paper Co., New York City.
Lineham & Molo, Paving Brick, Dubuque, Iowa.
Theo. Linington, Jr., Rock Salt, New York City.
Link-Belt Co., Clutch Couplings, etc., Chicago, Ill.
W. K. Linscott, Cross Ties, Mobile, Ala.
J. J. Little & Ives Co., Publishers, New York City.
C. S. Little, Druggists, New York City.
Lobdell Car Wheel Co., New York City.
Locke Insulator Mfg. Co., Insulators, Victor, N. Y.
Locomotive Appliance Co., Chicago., Ill.
Loch Bros., Aluminum, Lamp Black, N. Y. C.
Logan Iron Works, Brooklyn, N. Y.
Long & Allstatter Co., Punches and Shears, Hamilton, Ohio.
Long Bell Lumber Co., Kansas City, Mo.
The Longhead Co., Philadelphia, Pa.
Lord & Taylor, Clothing, New York City.
Harry A. Lord, Shovels, Allegheny, Pa.
Lortz-Leuscher Co., Furniture, Utica, N. Y.
C. T. Louis Co., New York City.
Louisiana Creosoting Co., Creosoted Lumber, Slidell, La.
Louisiana Molasses Co., New Orleans, La.
Love Brake Shoe Co., Chicago, Ill.
F. H. Lovell & Co., New York City.
Lowe & Leveridge, New York City.
John Lucas & Co., Paints, Philadelphia, Pa.
Lucas Machine Tool Co., Forcing Presses, Cleveland.
The Ludlow Mfg. Co., Loco. Oilers, Ludlow, Ky.
Ludowici-Celadon Co., Terra Cotta Roofing Tiles, Washington, D. C.
Ludowici-Celadon Co., Tile, Chicago, Ill.
Ludowici Roofing Tile Co., Ludowici, Ga.
Ludwig Baumann & Co., Furniture, New York City.
The Lunkenheimer Co., Engine Specialties, Cincinnatti, Ohio.
David Lupton's Sons Co., Windows, Phila., Pa.
Lutcher & Moore Lumber Co., Orange, Texas.
R. H. Luthin, Druggists, New York City.
Lynah & Reed, Baltimore, Md.
Lynchburg Foundry Co., Iron Pipe, etc., Lynchburg, Va.
Lynchburg Hosiery Mills, Lynchburg, Pa.
I. L. Lyons & Co., Ltd., New Orleans, La.
I. W. Lyons & Sons, Druggists, New York City.

M

Macbeth, Evans Glass Co., Pittsburgh, Pa.
Macbeth, Evans Hudson Glass Co., N. Y. C.
L. H. Mace & Co., Refrigerators, New York City.
R. H. Macy & Co., House Furnishing Goods, N. Y.
Macey-Wernicke Co., Furniture, New York City.
Charles Machine Co., Cleveland, Ohio.
The Macomber-Whyte-Moon Co., Wire Rope, N. Y.
The W. D. MacGuffin Co., Comsy. Sup., N. Y. C.
Walter Macleod & Co., Factory Specialties, Cincinnati, Ohio.
The MacMillan Co., Books, New York City.
James H. McCall, Pine Barren, Fla.
James H. McCall, Incinerators, Huntington, Tenn.
McClintic-Marshall Constn. Co., Steel, Pittsburgh.
J. J. McClusky, Paper Boxes, New York City.
McCord & Co., Railroad Supplies, New York City.
McCord & Co., Huntington, Tenn.
Henry J. McCoy Co., Contractors' Supplies, N. Y. C.
William McDonagh & Son, Nightsoil Pails, N. Y. C.
James A. McDonald, Lumber, New York City.
John W. McDonald, Glue, New York City.
James McKay Co., Chains, Pittsburgh, Pa.
McKesson & Robbins, Drugs, New York City.
H. McMullen, Sign Painter, New York City.
McNab & Harlin Mfg. Co., New York City.
McNeil & Higgins Co., Fruits, Chicago, Ill.
McNunally & McCrea, Cloth Goods, Atlanta, Ga.
Maendier Bros., Brushes, St. Paul, Minn.
M. Magee & Son, Switch Flags, New York City.
Ehret Magnesia Mfg. Co., Philadelphia, Pa.
Magnus' Metal Co., Journal Bearings, Buffalo, N. Y.
Magor Car Co., Flat Cars, New York City.
George S. Mahana, New York City.
Mahoney Electric Co., St. Louis, Mo.
O. J. Maigne Co., Printers' Rollers, New York City.
The Maine Elec. Co., Elec. Cranes, Portland, Me.
The Guy C. Major Co., Oil, Toledo, Ohio.
Mal & Brinker Co., New York City.
W. B. Malay, New York City.
Malt Diestase Co., New York City.
Maney Milling Co., Flour, Omaha, Neb.
Mann Edge Tool Co., Louistown, Pa.

Manhattan Brass Co., New York City.
Manhattan Electric Supply Co., New York City.
Manhattan Electrical Supply Co., New York City.
Manhattan Shirt Co., New York City.
The Manhattan Rubber Mfg. Co., Baltimore, Md.
The Manhattan Rubber Co., Passaic, N. J.
The Manhattan Supply Co., New York City.
Manicure Novelty Manufacturing Co., N. Y. C.
Manning, Maxwell & Moore, Tools and Sup., N.Y.C.
Marine Oil Co., New Orleans, La.
Marine Mfg. & Supply Co., Anchors, N. Y. C.
The Marion Steam Shovel Co., Marion, Ohio.
Mark Mfg. Co., Wrought Iron Pipe, Chicago, Ill.
A. A. Marks, Artificial Limbs, New York City.
D. B. Martin Co., Neatsfoot Oil, Philadelphia, Pa.
James C. Martin, School Books, Richmond, Va.
William Martinez & Co., Shoes, New Orleans, La.
Maryland Casualty Co., Bonding Employees, Baltimore, Md.
Maryland Steel Co., Steel Dump Barges, Baltimore.
Marquardt Co., Groceries, New York City.
John W. Masbury & Son, Paints and Varnish, N. Y.
Mathers & Lamm Paper Co., Washington, D. C.
The Mathews Boat Co., Port Clinton, Ohio.
R. T. Matteson & Co., Packers, Petersburg, Va.
A. D. Matthews Sons, Dept. Store, Brooklyn, N. Y.
John Matthews, Syrup, New York City.
Messrs. Mattlage, Fish Packers, New York City.
Henry Mauer & Son, Fire Brick, New York City.
Maxwell & Crouch Mule Co., St. Louis, Mo.
Mayer, Lane & Co., New York City.
Mead-Morrison Mfg. Co., Steel Shovels, N. Y. C.
Mechanical Mfg. Co., Bumping Posts, Chicago, Ill.
Mechling Bros. Mfg. Co., Caustic Soda, Camden, N.J.
Mehlbach Saddle Co., New York City.
Meir & Goetz, Wearing Apparel, New York City.
Richard W. Meirs, Philadelphia, Pa.
Melachrino & Co., Tobacco, New York City.
Mellen's Food Co., Boston, Mass.
J. H. Menge & Sons, New Orleans, La.
Mennen's Chemical Co., Toilet Articles, Newark, N.J.
Merchant & Evans Co., Condensor Tubes, Phila., Pa.
Merchants Fruit & Produce Co., New Orleans, La.
Merck & Co., Creoline, New York City.
Merrill-Stevens & Co., Barges, Jacksonville, Fla.
Merriman Bros., Snatch Blocks, Boston, Mass.
Merriman Paper Co., New York City.
L. J. Merriman, Piling, Switch Ties, Wilmington, N.C.
Merritt-Chapman Derrick & Wrecking Co., N.Y.C.
L. J. Merryman, Piling, Wilmington, N. C.
Meswick Coal Co., New York City.
The Meurer Bros. Co., Metals, New York City.
Meyer Bros. Drug Co., St. Louis, Mo.
Meyers Bros., Pads, New York City.
John Meyers, Vegetables & Fruit, New Orleans, La.
Henry H. Meyer, Hoisting Engines and Steam Connections, Baltimore, Md.
J. C. Meyer, Lowell, Mass.
E. B. Meyrowitz, Surgical Instruments and Hospital Supplies, New York City.
Mfg. Equipment & Engine Co., Boston, Mass.
H. Michelson & Co., Drugs, New York City.
Michigan Condensed Milk Co., New York City.
Michigan Leather Co., Detroit, Mich.
John Middleton, Tobacco, Philadelphia, Pa.
Midvale Steel Co., New York City.
Midvale Steel Co., Philadelphia, Pa.
Milam-Morgan Co., Ltd., Rice Straw, New Orleans.
The Alexander Milburn Co., Baltimore, Md.
Millburn Wagon Co., Toledo, Ohio.
Alexander Milburn Co., Acetylene Gas Machines and Lamps, Baltimore, Md.
Alfred Miller Co., Ltd., Cement, New Orleans, La.
L. H. Miller Safe & Iron Works, Baltimore, Md.
H. C. Miller Co., Stationery, New York City.
J. Miller Sons & Co., Clothing, Philadelphia, Pa.
Thomas Miller Bros., Iron Work, Philadelphia, Pa.
Miller Pasteurizing Machine Co., Canton, Ohio.
Miller, Aikenhead, Wearing Apparel, N. Y. C.
Miller & Graham, Lamp Black, Coal Tar, Oil and Turpentine, Baltimore, Md.
George W. Millar & Co., Paper, New York City.
O. A. Miller, Shoe Trees, Brockton, Mass.
E. Miller & Sons, Illuminating Oil & Lamps, N.Y.C.
W. L. Mills, Washington, D. C.
Anson Mills, Esq., Washington, D. C.
W. H. Miner & Co., Gravity Side Bearings, Chicago, Ill.
Minnesota Linseed Oil Paint Co., Minneapolis, Minn.
Minnesota Mining & Mfg. Co., Paper, Chicago, Ill.
Minus, Nugent Co., New York City.
Mississippi Lumber Co., Quitman, Miss.
Missouri Malleable Co., E. St. Louis, Mo.
Mitchell Clay Manufacturing Co., St. Louis, Mo.
Mobile Stove & Pulley Mfg. Co., Mobile, Ala.
Model Gas Engine Works, N. Y. C.
Modern Frog & Crossing Works, Chicago, Ill.
Mohawk Condensed Milk Co., New York City.
Moller & Schuman Co., Varnish, Brooklyn, N. Y.
Monarch Biscuit Co., New York City.
Monarch Engrg. & Mfg. Co., Material for Furnaces, Baltimore, Md.
Monarch Steel Casting Co., Detroit, Mich.
Monarch Suspender Co., New York City.
Monel Metal Manufacturing Co., New York City.
Montgomery, Ward & Co., Chicago, Ill.
Montgomery & Co., Wrenches, Drills, etc., N. Y. C.
Moonstone Copying Slate Co., Columbus, Ohio.
J. J. Moore & Co., Inc., San Francisco, Cal.
Moos & Co., Packers, New York City.
Moran Flexible Steam Joint Co., Louisville, Ky.
Moran Towing & Transportation Co., N. Y. C.
J. A. Moray, New York City.
The Morgan Engineering Co., Alliance, Ohio.
Enoch Morgan's Sons Co., Sapolio, N. Y. C.
Morris Machine Works, Pumps, Baldwinsville, N. Y.
Morris & Co., Clothing, Baltimore, Md.
Nelson Morris & Co., Chicago, Ill.
T. N. Morris & Co., Dry Goods, New York City.
James E. Morris, Groceries, New York City.

Philip Morris & Co., Cigarettes, New York City.
Morse-Boulger Destructor Co., New York City.
F. J. Morse Supply Co., Linen Wear, New York City.
Morse & Rogers, Novelties, New York City.
A. J. Morse & Son, Wearing Apparel, Boston, Mass.
Mosaic Tile Co., Zanesville, Ohio.
The Mosaic Tile Co., Tiling, New York City.
A. Moses & Sons, Inc., Sponges, New York City.
W. B. Moses & Sons, Furniture, Washington, D. C.
Mosher Water Tube Boiler Co., New York City.
Mosler Safe Co., Hamilton, Ohio.
Henry Moss & Co., Machinery, New York City.
Mothersill Remedy Co., Medicines, N. Y. C.
J. L. Mott Iron Works, Washington, D. C.
H. Mueller Mfg. Co., Plumbing and Gas Fixtures, New York City.
H. K. Mulford Co., Vaccine Points, New York City.
Mundet & Co., Corks, Brooklyn, N. Y.
Municipal Engineering & Contracting Co.,Chicago.
Henry Mungesser & Co., Grass Seed, New York City
John Munora Co., Commission Mer., New Orleans.
Munson S. S. Line, New York City.
Munson Supply Co., Stationery, New York City.
Murphysboro Paving Brick Co., Paving Brick, Murphysboro, Ill.
George Murphy, Inc., Paper Cap Slides, etc., Photo Supplies, New York City.
Murphy Varnish Co., Newark, N. J.
E. A. Murray, Chemical Mfgs., Detroit, Mich.
F. E. Myers & Bros., Knapsack Pumps, Ashland, Ohio.
Myles Salt Co., New Orleans, La.

N

Nasen Comp. & Paint Co., New York City.
Nason Mfg. Co., Boilers and Radiators, N. Y. C.
The Nassau Smelting & Refining Works, N. Y. C.
Nathan Mfg. Co., Injectors and Lubricators, N.Y.C.
The National Ammonia Co., New York City.
National Aniline & Chemical Co., New York City.
National Biscuit Co., Chicago, Ill.
The Nat. Brass & Copper Tube Co., N. Y. C.
National Carbon Co., Cleveland, Ohio.
National Cash Register Co., Dayton, Ohio.
National Casket Co., New York City.
National Conduit & Cable Co., New York City.
National Drill & Mfg. Co., Scrapers, New York City.
National-Filton Brass Mfg. Co., Detroit, Mich.
National Fire Proofing Co., Chicago, Ill.
National Flour Mills, San Francisco, Cal.
National Electrical Supply Co., Washington, D. C.
National Enamel & Stamping Co., New York City.
National Folding Box & Paper Co., New York City.
National Gum & Mica Co., Glue, New York City.
National India Rubber Co., Providence, R. I.
The National Lock Washer Co., Newark, N. J.
National Malleable Castings Co., Cleveland, Ohio.
National Malleable Casting Co., New York City.
National Meter Co., New York City.
National Motor Co., New York City.
National Oil Works & Mill Supply Co., Ltd., New Orleans, La.
National Packing Co., Chicago, Ill.
Nat. Railway Pub. Co., Magazines, New York City.
National Railway Supply Co., New York City.
National Roller Co., Composition for Printers' Rolls, New York City.
National Scales Co., Buffalo, N. Y.
National Show Case Co., New York City.
The National Signal Flag Co, Warrenton, Va.
The National Ticket Co., Cleveland, Ohio.
National Vaccine & Antitoxin Establishment, Washington, D. C.
S. E. & L. E. Naylor, Lumber Co., Gulfport, Miss.
Neale & Brinker Co., Hardware, New York City.
T. S. & J. D. Negus, Signal Flags, New York City.
H. L. Nelke & Co., Wearing Apparel, Phila., Pa.
Neostyle Co., Mimeograph Machines, N. Y. C.
Nelson Goodyear, Gas Apparatus, New York City.
The Charles Nelson Co., San Francisco, Cal.
The A. & J. Nelson Mfg. Co., Stove Pipe, New Orleans, La.
Neptune Meter Co., New York City.
Nernst Lamp Co., New York City.
Nestles Food Co., New York City.
Nestor Gianaclis Co., Cigarettes, New York City.
Nev-a-Hone Razor Strop Co., New York City.
New Castle Forge & Bolt Co., New Castle, Pa.,
New England Confectionery Co., Boston, Mass.
New England M. S. Co., Maple Syrup, Boston, Mass.
Newhall Chain Forge & Iron Co., New York City.
New Iberia Tabasco Sauce Co., New Iberia, La.
The Newman Clock Co., Chicago, Ill.
J. J. Newman Lumber Co., St. Louis, Mo.
New Haven Clock Co., New York City.
New Home Sewing Machine Co., New York City.
The New Freedom Wire Cloth Co., Chicago, Ill.
The New Freedom Wire Cloth Co., New Freedom, Pa.
Newmeyer & Dimond, Floating Cranes, N. Y. C.
New Orleans Furniture Co., New Orleans, La.
New Orleans Tent & Awning Co., New Orleans, La.
Newport News Ship & Dry Dock Co., Newport News Va.
New Process Rawhide Co., Syracuse, N. Y.
Newson & Co., Books & Charts, New York City.
New Jersey Asbestos Co., Camden, N. J.
New Jersey Car Spring & Rubber Co., Jersey City, N.J.
New Jersey Foundry & Mach. Co., New York City.
New Jersey School Furniture Co., Trenton, N. J.
New Jersey Wire Cloth Co., Camden, N. J.
The New York Air Brake Co., New York City.
The New York Boat Oar Co., New York City.
N. Y. Belting & Packing Co., Ltd., New York City.
New York Buff Co., Polishers' Supplies, N. Y. C.
New York Electric Installation Co., N. Y. C.
New York Filing Cabinet Co., New York City.
New York Frame & Picture Co., New York City.
New York Hollow Ware Co., New York City.

New York Ice Machinery Co., New York City.
New York Insulated Wire Co., New York City.
New York Ladder Co., New York City.
New York Roofing & Corrugating Co., Phila., Pa.
New York Sand & Facing Co., Brooklyn, N. Y.
N. Y. Shipbuilding Co., Camden, N. J.
New York Shellac Co., New York City.
New York Stencil Works, New York City.
New York White Cross Milk Co., New York City.
New York & Brooklyn Casket Co., New York City.
Niagara Machine & Tool Works, Buffalo, N. Y.
Nicholson File Co., Providence, R. I.
The Nile Tobacco Co., New York City.
Niles-Bement-Pond Co., Lathe, Planer, Drilling Machines, New York City.
The Nilson Yacht Building Co., Boats, Baltimore.
H. A. Noble, Philadelphia, Pa.
Noble & Salter, Com. Mer., New Orleans, La.
William R. Noe Co., Hardware, New York City.
Nollman & Co., Butter, New York City.
Charles H. Nolte, Commission Merchant, N. Y. C.
Nonpareil Cork Works, New York City.
Northern Elec. Mfg. Co., Madison, Wis.
Northwestern Malleable Iron Co., Milwaukee, Wis.
The Northwestern Miller, Minneapolis, Minn.
A. O. Norton, Jacks, Boston, Mass.
Norvell-Shapleigh Hardware Co., St. Louis, Mo.
Norwood Tool Co., Wheeling, West Va.
William W. Nugent & Co., Tanks, Oils and Mach. Chicago, Ill.
Nunglsser, Deshensen Seed Co., New York City.
Nye Steam Pump & Mfg. Co., Chicago, Ill.

O

Oakman Bros., New York City.
John Obenberger Co., Buckets, Milwaukee, Wis.
The S. Obermayer Co., Cincinnati, Ohio.
The Obermayer Co., Inc., Ship Tenders, N. Y. C.
Obermayes Co., Marine Supplies, New York City.
M. O'Brien & Son, Vegetable Merchants, N. Y. C.
P. H. O'Day & Son, Pattern Makers, N. Y. C.
Office & School Supply Co., New York City.
Ogden & Wallace, Iron and Steel, New York City.
J. Edward Ogden Co., Hardware, New York City.
Ogden Iron & Steel Mfg. Co., New York City.
The Ohio Brass Co., Insulators, Mansfield, Ohio.
Ohio Filler & Shield Co., Lubricating Oils, Columbus.
The Ohio Injector Co., Wadsworth, Ohio.
Ohio Valley Furniture Co., Charleston, W. Va.
The James Ohlen & Sons Saw Mfg. Co., Columbus.
Oil City Boiler Works, Oil City, Pa.
Okonite Co., Insulated Wires and Cables, N. Y. C.
Joshua Oldham & Sons, Saws for Metal and Wood, New York City.
Olerich & Son, Brooklyn, N. Y.
D'Olier Engineering Co., Boiler Plants, Phila., Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Oliver Machinery Co., New York City.
Oliver Typewriter Co., New York City.
The William J. Oliver Mfg. Co., Dump Carts, Knoxville, Tenn.
A. Olsen, New York City.
Olson, Mahony Lumber Co., San Francisco, Cal.
O'Neill-Adams Co., Department Store, N. Y. C.
Orenstein-Arthur Koppel Co., Industrial and Portable Railways, New York City.
Orleans Metal Building Co., New Orleans, La.
John C. Orr & Co., Brooklyn, N. Y.
Orton & Steinbrenner, Locomotive Coaling Cranes, Chicago, Ill.
W. R. Osborn, Lawyer, Passaic, N. J.
R. C. Osburn, Paper and Twine, Philadelphia, Pa.
Osburn Paper Co., Philadelphia, Pa.
Oshkosh Mattress Co., Oshkosh, Wis.
Oster Bros., Trucks, New Orleans, La.
Ostermoore & Co., Furniture, New York City.
Ostrander Fire Brick Co., New York City.
O'Sullivan Rubber Co., Rubber Heels, Lowell, Mass.
Otis Elevator Co., New York City.
Spencer Otis Co., Tie Plates, Chicago, Ill.
Ottawa Silica Co., Sand for Cement Testing, Ottawa, Ill.
Ira Ottenberg, Corn Cob Pipes, New York City.
The Otto Gas Engine Works, Chicago, Ill.
Outing Shoe Co., Boston, Mass.
Randolph Owens, New York City.
C. W. Owston, Jr., Carpenters' Tools, Maplewood N. J.
Oxford Chemical Co., Boston, Mass.
The Oxy-Acetylene Appliance Co., New York City.

P

Pacific Coast Condensed Milk Co., New York City.
Pacific Novelty Co., Combs, New York City.
Packer Manufacturing Co., Soap, N. Y. C.
The Page Belting Co., Concord, N. H.
Pain Fireworks Display Co., New York City.
Palmer Bros., Motors, Cos Cob, Conn.
Palmer Lumber Co., San Francisco, Cal.
Panama Lumber & Trading Co., New Orleans, La.
The Paraffine Paint Co., Chicago, Ill.
Paragon Electric Co., Wire, Chicago, Ill.
Paragon Sellers Co., Chicago, Ill.
Park & Tilford, Groceries, New York City.
Park, Bensinger & Co., General Supplies, N. Y. C.
William T. Parke, Shoes, New York City.
Parker, Davis & Co., Pyrethum Powder, N. Y. C.
Parker-Fain Grocery Co., New Orleans, La.
Parker Pen Co., Janesville, Wis.
William H. Parkerton, Wire Works, New York City.
Parkinson Coal & Coke Co., Brooklyn, N. Y.
W. A. Parsons & Co., Tinware, Durham Cra., Conn.
Parsons & Whittemore, Paper, New York City.
Parsons Bros., Paper, New York City.
The Parsons Trading Co., New York City.

Paterson Parchment Paper Co., Passaic, N. J.
C. T. Patterson Co., Ltd., Drill Machinery, etc., New Orleans, La.
Patterson, Gottfried & Hunter, Stakes, Shears, etc., New York City.
Patterson-Sargent Co., Varnishes, New York City.
R. A. Patterson Tobacco Co., Richmond, Va.
Patton Paint Co., Milwaukee, Wis.
E. Pearson & Co., Linoleum, New York City.
J. H. Pearson, Machinery, New York City.
Pears Soap Agency, New York City.
Peck Bros. & Co., Plumbing App., New Haven, Conn.
Peerless Dishwasher Co., Rochester, N. Y.
Peerless Electric Co., New York City.
Peerless Rubber Mfg. Co., New York City.
Pelton Water Wheel Co., New York City.
Penberthy Injector Co., Detroit, Mich.
M. Penderson Co., Com. Merch., New Orleans, La.
Penick & Ford, Molasses, New Orleans, La.
J. F. Pennell, Steel Castings, New York City.
Penn. Bridge Co., Towers for Radio Station, Beaver Falls, Pa.
Penn. Flexible Metallic Tubing Co., Phila., Pa.
Penn. Salt Manufacturing Co., Philadelphia, Pa.
Penn. Steel Casting & Machine Co., Chester, Pa.
The Pennsylvania Steel Co., Philadelphia, Pa.
Peoples Tobacco Co., New Orleans, La.
Perfumer Publishing Co., New York City.
The Perkins-Campbell Co., Harness, Cincinnati, O.
Peterman Chemical Co., New York City.
Petroleum Iron Works, Storage Tanks for Fuel Oil, Sharon, Pa.
Pettill & Reed, Groceries, New York City.
Pettinos Bros., Graphite Paint Blank, Bethlehem, Pa.
S. Pfeifer Co., Rice, New Orleans, La.
Philadelphia Machine Works, Philadelphia, Pa.
Phillips & Laffitte, Welding Plates, Phila., Pa.
Phillips, Jones Co., New York City.
Phinotas Chemical Co., New York City.
Phoenix Cheese Co., New York City.
Phoenix Iron Works, Meadville, Pa.
Phoenix Knitting Co., Milwaukee, Wis.
Phoenix Specialty Co., Corrugated Copper Gaskets, New York City.
Albert Pick & Co., Glass, Towels, Chicago, Ill.
Pierson & Co., Iron and Steel, New York City.
A. N. Pierson & Co., Plumbing Pipes, N. Y. C.
Pigot, Sayre & Co., Oils, New York City.
Pilling Air Engine Co., Detroit, Mich.
R. H. Pilson, Iron, Shafts, Ringbolts, Wash., D. C.
Pinney & Geddes, Cheese, New York City.
Pioneer Broom Co., Amsterdam, N. Y.
Pioneer Suspender Co., Philadelphia, Pa.
Pitt, Barnum & Co., Butter, New York City.
Pittsburgh Amiesite Co., Asphalt Mixing Plant, Pittsburgh, Pa.
Pittsburgh Forge & Iron Co., Pittsburgh, Pa.
Pittsburgh Metal Products Co., Pittsburgh, Pa.
Pittsburgh Plate Glass Co., New York City.
Pittsburgh Reduction Co., Aluminum, N. Y. C.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Pittsburgh Spring & Steel Co., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Pittsburgh Steel Foundry, Pittsburgh, Pa.
Pittsburgh Valve & Foundry Construction Co., Pittsburgh, Pa.
Pittsburgh White Metal Co., Metal Tape, N. Y. C.
Thomas G. Plant Co., Shoes, Boston, Mass.
George P. Plant Milling Co., St. Louis, Mo.
Fayette R. Plumb, Chisels, Philadelphia, Pa.
Plymouth Cordage Co., Rope and binder Twine, Plymouth, Mass.
J. M. Pyle & Son, Cleansing Powder, Edgewater, N. J.
Pocahontas Coke Co., Bramwell, W. Va.
Pocohontas Fuel Co., New York City.
Poland Spring Water Co., New York City.
Alexander Pollock Co., Hardware, New York City.
Pompeian Manufacturing Co., Cleveland, Ohio.
Poole Bros., Chicago, Ill.
Pormentheus Heating Co., New York City.
Portcosta Milling Co., San Francisco, Cal.
H. K. Porter Co., Locomotives, Pittsburgh, Pa.
Porter Safety Seal Co., Lead Seals, Chicago, Ill.
William Porters Sons Co., Fixtures, New York City.
Port Johnson Towing Co., New York City.
The Portland Co., Portland, Me.
Portland Cordage Co., Rope, Manila, Portland, Ore.
Post Pipe Co., Drain Tile, Texarkana, Ark.
Postum Cereal Co., Battle Creek, Mich.
Potomac Electric Power Co., Washington, D. C.
Potter Drug & Chemical Co., Boston, Mass.
D. H. Potts, Forges, Lancaster, Pa.
William Powell Co., Valves, Globes, etc., Cincinnati.
A. M. Powell, New York City.
Power & Mining Co., Cudahy, Wis.
Power Specialty Co., Reheaters, New York City.
Pratt & Whitney Co., Automatic Weighing Machines, New York City.
Pratt & Whitney, Machine Punches, Cutters, etc., Hartford, Conn.
Prentiss Tool & Supply Co., New York City.
S. F. Prentzel, Philadelphia, Pa.
Pressed Steel Car Co., Pittsburgh, Pa.
Prince Manufacturing Co., Paints, New York City.
Procter & Gamble Co., Soap and Candles, Cincinnati.
Progressive Paper Products Co., New York City.
T. C. Prouty Co., Ltd., Albion, Mich.
Provident Chemical Works, New York City.
The Pulp & Paper Trading Co., New York City.
The Pure Baking Powder Co., New York City.
The Pure Oil Co., Brooklyn, N. Y.
Purington Paving Brick Co., Galesburg, Ill.
The Pusey & Jones Co., Tow and Tug Boats, Wilmington, Del.
Pyles Nat. Electric Headlight Co., Chicago, Ill.

Q

Quaker City Rubber Co., New York City.
Quaker Oats Co., Chicago, Ill.
Queen & Co., Tracing Cloth and Sup., Phila., Pa.
Queen City Supply Co., Canvas Bolting, Cincinnati.
Quincy, Manchester & Sargent, New York City.

R

Rahtgen's American Composition Co., Anti-Corrosive Compound, New York City.
The Rail Joint Co., New York City.
The Railway Appliance Co., Machinery, Chicago, Ill.
Railway Steel Spring Co., New York City.
Railway & Traction Supply Co., Chicago, Ill.
Ramies & Co., Metal Polish, New York City.
Rampo Foundry & Wheel Works, Rampo, N. Y.
Rand, McNally Co., Publishers & Printers, N. Y. C.
John C. Rankin Co., Stationery, New York City.
Ransom, Parker & Co., Paper, New York City.
Ransome Concrete Machinery Co., Dunellen, N. J.
Raritan Chemical Works, New York City.
The Raritan Paint Co., New York City.
Rathbone Sard & Co., Stoves, Albany, N. Y.
Rawles-Cobb Co., Factory & Mach. Sup., Boston.
W. S. Ray Manufacturing Co., Galvanized Corrugated Stove Pipe Elbows, San Francisco, Cal.
A. J. Reach, Sporting Goods, Philadelphia, Pa.
Reading Hardware Co., New York City.
Reading Iron Co., Reading, Pa.
Remington & Sherman, Safes, New York City.
The Record Oil Refining Co., New Orleans, La.
Rector Help-o-phone Co., New York City.
Red Wing Milling Co., Red Wing, Minn.
S. E. Redfern, New Orleans, La.
Reeb & Dinkins, Doors & Sashes, New York City.
Reed Murdock Co., Chicago, Ill.
Reeves Pully Co., Columbus, Ohio.
Eli J. Reicer Co., Show Cases & Store Fixtures, N. Y.
Alex Reid, Engine Boiler Makers, New York City.
James Reilly Repair & Supply Co., Heaters, New York City.
W. Reinerth & Co., Hats, New Orleans, La.
Reiss & Brady, Canning Co., New York City.
Remington Machine Co., Refrigerating and Ice Making Plants, Wilmington, Del.
Remington Typewriter Co., New York City.
Repetti Co., Candy, New York City.
Reppenhagen Cutlery Co., Highland Falls, N. Y.
Republic Bag & Paper Co., New York City.
Republic Metal Ware Co., New York City.
The Republic Rubber Co., Rubber Hose, Youngstown, Ohio.
Clement Restein Co., Packing, Philadelphia, Pa.
Revere Rubber Co., New York City.
J. Reyner, Supplies, Newport News, Va.
E. C. Reynolds, Steam Tugboat, New York City.
R. J. Reynolds Tobacco Co., Winston-Salem, N. C.
Reynolds & Irving, Groceries, New York City.
Louis P. Rice & Co., Harness, New Orleans, La.
Rice, Stix Dry Goods Co., St. Louis, Mo.
Richard Mfg. Co., Miter Forcing Machine, Bloomsburg, Pa.
The Frank Richardson Laundry Supply Co., N. Y. C.
Richardson Silk Co., Thread, Chicago, Ill.
H. Richters Sons, Neckwear, New York City.
Ridabock & Co., Wearing Apparel, New York City.
Ridgeway Mfg. Co., Wearing Apparel, Trenton, N.J.
Riggs & Bro., Standard Compensating Binnacle, Philadelphia, Pa.
Riker & Hegeman, Drugs, New York City.
Theo. Ricksecker Co., Druggists, New York City.
F. A. Ringler, Electrotypers, New York City.
Ritz-Carlton Hotel Co., New York City.
Riverside Mills, Inc., Cotton Waste, Augusta, Ga.
J. B. Roache, Contractor, Brooklyn, N. Y.
The Robb Mumford Boiler Co., Inc., N. Y. C.
The Roberts Motor Co., Gasoline Motor, Sandusky, Ohio.
Roberts, Johnson & Rand, Shoes, St. Louis, Mo.
C. E. Robidoux, Lathe, Carborundum Wheels, St. Louis, Mo.
A. Robertson & Sons, Doors, Binghampton, N. Y.
James L. Robertson & Son, Machine Supplies, N. Y.
The Robinson Lumber Veneer & Box Co., New Orleans, La.
The Robinson Clay Product Co., Filters and Coolers, New York City.
Rockwood & Co., Chocolate and Cocoa, N. Y. C.
Rochester Stamping Co., Hardware Specialties, Rochester, N. Y.
Rockland-Rockport Lime Co., New York City.
Rockhill & Victor, Wholesale Druggists, N. Y. C.
L. A. Rockwell & Co., Baking Machines, New York.
W. C. Rodgers, Flooring, Hattiesburgh, Miss.
John A. Roebling's Sons Co., Wire Rope and Wire Goods, Trenton, N. J.
Roe Stephens Mfg. Co., Detroit, Mich.
Roessler & Hasslacher, Chemicals, New York City.
Roger Ballast Car Co., Chicago, Ill.
H. A. Rogers Co., Railway Supplies, New York City.
Rohe & Bro., Packers, New York City.
Rome Brass & Copper Co., Rome, N. Y.
P. H. & F. H. Roots Co., Cupalo Blowers, Connersville, Ind.
Rosaler Safe & Lock Co., New York City.
Rosen & Hermann, Shirts, New York City.
R. Rosenberg & Sons Co., San Francisco, Cal.
Rosenberg Bros. Co., San Francisco, Cal.
Samuel Rosenblatt, New York Soap Works, N.Y.C.
H. Rosenthall & Bro., Paint Brushes, N. Y. C.
Rosenthal Bros., Cigars, New York City.
Rosedale Foundry Co., Cylindrical Valves, Pittsburgh, Pa.
Harry & Morris Rosenwasser, Leggings, N. Y. C.
Ross-Meehan Foundry Co., Chattanooga, Tenn.
John Rothschild & Co., Food Products, San Francisco, Cal.

R. P. Rowe, Fire Extinguishers, New York City.
E. W. A. Rowles, Railroad and Steamship Books, Chicago, Ill.
The Royal Eastern Elec. Supply Co., N. Y. C.
Royal Mfg. Co., Wool Waste, Rahway, N. J.
Royal Manufacturing Co., Cotton, New York City.
Rubberbound Brush Co., Belleville, N. J.
Rubberhide Co., Boots and Rubber Goods, Boston.
Rubberset Co., Brushes, New York City.
Rubens & Meyer, Clothing, New York City.
Rudolph & West Co., Hardware, Washington, D. C.
Ruddock Orleans Cypress Co., Cypress Switch Ties, New Orleans, La.
Rueff Bros., Novelties and Jewelry, New York City.
L. M. Rumsey Mfg. Co., Galvanized Pipe, St. Louis.
Rumsey Pump Co., New York City.
Runckle Bros., Cocoa, New York City.
Rushmore Dynamo Works, Plainfield, N. J.
Russell, Burdsall & Wood, Bolt & Nut Co., Port Chester, N. Y.
Russell & Erwin, Hardware, New York City.
Russian Caviar Co., New York City.
John T. Ryerson & Son, Punching Machs., etc., Chicago, Ill.

S

Sable Bros., Hats, New York City.
Safety Armorite Conduit Co., Pittsburgh, Pa.
The Safety Insulated Wire & Cable Co., N. Y. C.
H. W. St. Charles Condensed Milk Co., N. Y. C.
H. W. St. Johns, Horlick's Malted Milk, N. Y. C.
Salant & Salant, Shirts, New York City.
Salem Brick & Lumber Co., New Orleans, La.
Sallade & Co., Insect Exterminator, N. Y. C.
Salmon Lumber Co., New Orleans, La.
M. Salzbery, Stationery, New York City.
Samuel Cupples Engraving Co., New York City.
Frank Samuels, Pig Iron and Alloys, Phila., Pa.
Sanatol Chemical Laboratory Co., St. Louis, Mo.
San-Knit-ary Textile Mills, Philadelphia, Pa.
R. P. Le Sassier, New Orleans, La.
J. R. Saunders Co., Turpentine, New Orleans, La.
Sawyer Belting Co., Cleveland, Ohio.
Sawyer-Mann Lamp Co., New York City.
Sargent & Co., Hardware, New York City.
Sayles-Zahn Co., Packers, New York City.
Charles Schaefer, Feed, Brooklyn, N. Y.
H. A. Schafer, Comsn. Merchant, New York City.
Schaffer & Budenburg Mfg. Co., New York City.
J. A. Schatzberg, Hardware, New York City.
Mr. Edward Schenk, Buckets, York, Pa.
Henry Schief, Wearing Apparel, New York City.
Schiefflein & Co., Wholesale Druggists, N. Y. C.
Charles A. Schieren Co., Leather Belting, N. Y. C.
Nathan Schivertzer, Comsn. Merchant, N. Y. C.
Enos F. Schlichter, Water Tanks, Phila., Pa.
Fred A. Schmidt, Blue Print Paper, Wash., D. C.
H. A. Schnackenberg, New York City.
Schoen-Jackson Co., Bronze Hose, Media, Pa.
Julian Scholl & Co., Steam Rollers, New York City.
Schoverling, Daly & Gales, Photography Sup. N. Y.
A. Schraeder's Son, Inc., Materials, New York City.
J. H. Schriber & Co., Clothing, New York City.
L. Schulmann & Sons, Patterns for Uniforms, N. Y.
Schuls Bakery Co., Bakery Supplies, Chicago, Ill.
Schultz Patent Rubber Co., Rubber Valves, Phila.
Richard Schuster, New York City.
Schutts & Koerting Co., Valves, Philadelphia, Pa.
J. & M. Schwabacher, Com. Merch., New Orleans.
S. M. Schwab, Jr.,& Co.,Dry Goods, Draperies, N.Y.
Joseph Schwartz Co., Ltd., Wagonettes, New Orleans, La.
C. L. Schwartz, St. Louis, Mo.
Schwartzchild & Sulzberger, Packers, Chicago, Ill.
Scott Manufacturing Co., Racine, Wis.
St. Louis Screw Co., Brass Bolts, St. Louis, Mo.
John Scully & Thomas J. Scully, Perth Amboy, N. J.
Seaboard Trading Co., New York City.
C. L. Seabury & Co., Launch, Morris Heights, N. Y.
Seafoam Baking Powder Co., New York City.
The Seagrave Co., Wagons, Columbus, Ohio.
Seaman, Lichtenstein, Comsn. Merch., N. Y. C.
Theodore C. Search, Philadelphia, Pa.
James W. Sederguest, Bolts, Boston, Mass.
Seeman Bros., Groceries, New York City.
S. Segari & Co., Vegetables and Fruit, New Orleans.
William Sellers & Co., Inc., Slotters, Parallel Driver Planer, Philadelphia, Pa.
H. J. Seward & Co., General Supplies, Baltimore.
J. F. Sexton, Plumbers, New York City.
S. B. Sexton Stove & Mfg. Co., Baltimore, Md.
Selby Smelting & Lead Co., San Francisco, Cal.
Self-Winding Clock Co., New York City.
Charles P. Semmelhack, Chemists, Chicago, Ill.
Shaw & Leopold, Pipe, Philadelphia, Pa.
James K. Shaw, Crockery, New York City.
Shawiningan Carbide Co., New York City.
Samuel T. Shaw, New York City.
Shawmut Clay Manufacturing Co., New York City.
Shaw-Walker Co., Filing Cabinets, Chicago, Ill.
D. W. Shayer & Co., Hammocks, New York City.
Sherburne & Co., Boston, Mass.
Sherwin-Williams Co., Paints and Varnish, Newark, N. J., and Cleveland, Ohio.
James Shewann & Sons, Dry Goods, New York City.
The Shipley Construction Co., Chemicals, N. Y. C.
Shredded Wheat Co., Niagara Falls, N. Y.
A. Shuttleworth, Keilles & Co., Woodware, N. Y. C.
Shaw Electric Crane Co., New York City.
Sherman, Brown & Clement, Tools and Machine Parts, New York City.
Sherman Brown & Co., Steel Materials, N. Y. C.
Richard B. Sherman, Drills, New York City.
Charles E. Sholes Co., Carbolic Acid, New York City
F. Simon Goldberg Co., New York City.
Robert H. Sizer & Co., Trestles, Timber, N. Y. C.
Siegel-Cooper Co., Department Store, N. Y. C.
Sigmund Eisner, Khaki Goods, Red Bank, N. J.
John Simmons Co., Plumbing Supplies, N. Y. C.

Simmons Team Mule Co., Fort Worth, Texas.
William Simons & Co., Steel Bucket Dredge, Renfrew, Scotland.
Simplex Electrical Heating Co., New York City.
Simplex Railway Appliance Co., New York City.
Simpson Crawford Co., Office Furniture, N. Y. C.
The Sims Co., Brackets, New York City.
Singer Sewing Machine Co., New York City.
Theodore Sinington, Jr., Brooms, New York City.
S. R. Slaymaker, Lancaster, Pa.
Smaltz, Goodwin Co., Shoes, Philadelphia, Pa.
L. C. Smith & Bros., Typewriter Co., New York
Theodore Smith & Sons Co., Excavating Buckets, Jersey City, N. J.
Smith & Thompson, Stationery, New York City.
Smith Bros., Soap, Coffee and Tea, New Orleans, La.
Augustus Smith, Coal Handling Equipment, Bayonne, N. J.
The T. L. Smith Co., Concrete Mixers, Milwaukee.
C. F. Smith, Lights, New York City.
H. D. Smith Machine Co., Chisels and Wheels, Smithville, N. J.
Smith-Premier Typewriter Co., Washington, D. C.
Thomas J. D. Smith, Range Tower Lanterns, Newark, N. J.
Smith Worthington Co., Harness and Sup., N. Y. C.
Sneath Glass Company, Globes, Hartford City, Ind.
N. Snellenburg & Co., Furniture, Philadelphia, Pa.
Snellenburg Cloth. Co., New York City.
T. W. Snow Construction Co., Stand Pipe Parts, Chicago, Ill.
George H. Snow, Shoes, Brockton, Mass.
Snow Steam Pump Works, New York City.
Alvin W. Snyder, Water Pumps, Canton, Ohio.
E. G. Soltmann Co., Drawing Materials, N. Y. C.
Somers & Son, San Francisco, Cal.
L. Sonneborn Sons, Oil., New York City.
B. Soute & Co., Furniture, New York City.
South Atlantic Car & Mfg. Co., Wooden Flat Cars, Waycross, Ga.
Southern Creosoting Co., Ltd., New Orleans, La.
Southern Creosoting Co., Yellow-Pine Creosoted Cross-Ties, Slidell, La., and New Orleans, La.
Southern Electric Co., Baltimore, Md.
Southern Exporting Co., New Orleans, La.
Southern Trading Co., Bolts, Tallow, New Orleans.
Southern Printers Supply Co., Washington, D. C.
Southern Saw-Mills Co., New Orleans, La.
A. G. Spalding & Bros., Sporting Goods, N. Y. C.
Donald B. Spanogla, Steel Material, Lewiston, Pa.
Elgin Sparks, Kansas City, Mo.
Sparks Milling Co., Flour, Alton, Ill.
C. W. Sparks, Mules, Kansas City, Mo.
Sparrows Point Store Co., Dredge Equipment, Baltimore, Md.
Speakman Supply & Pipe Co., Wilmington, Del.
Alden Speare Sons Co., Supplies, New York City.
The Speddlen Shipbuilding Co., Baltimore, Md.
Spencer Optical Co., New York City.
Sperry Flour Co., San Francisco, Cal.
John H. Spohn Co., San Francisco, Cal.
Spotswood-Turner Lumber Co., Mobile, Ala.
Sprague Electric Co., Jersey City, N. J.
Sprague Electric Co., New York City.
Sprauley & Reed, New Orleans, La.
N. Stafford Co., Badges and Checks, N. Y. C.
Stallman & Fulton Co., Pyrethrum, New York City.
The Stamford Foundry Co., Stamford, Conn.
Standard Chain Co., Pittsburgh, Pa.
Standard Foundry Co., Iron Castings, Buffalo, N. Y.
Standard Furnace & Range Co., Louisville, Ky.
Standard Mfg. Co., Camp Chairs, Cambridge City, Ind.
Standard Oil Co., Lubricating Dept., Baltimore, Md.
Standard Oil Co., New York City.
Standard Paint Co., New York City.
Standard Sanitary Mfg. Co., Closets, York, Pa.
Standard Scale & Supply Co., New York City.
The Standard Scale & Supply Co., Pittsburgh, Pa.
Standard Steel Car Co., Flat Cars and Repairs, Pittsburgh, Pa.
Standard Steel Works, New York City.
Standard Turpentine Co., New York City.
Standard Underground Cable Co., New York City.
Standard Underground Cable Co., Pittsburgh, Pa.
Standard Varnish Co., New York City.
Standard Water Meter Co., New York City.
Standard Wire Mattress Co., Boston, Mass.
Stanley & Patterson, Electric Supplies, N. Y. C.
Stanley Jordan & Co., Chloride of Lime, N. Y. C.
Stanley Rule & Level Co., New York City.
The Stanley Works, Steel Goods, New York City.
Stannard-Tilton Milling Co., Flour, St. Louis, Mo.
Star & Crescent Milling Co., Chicago, Ill.
Star Brass Manufacturing Co., New York City.
Starffer, Eshleman & Co., Ltd., Hardware, New Orleans, La.
Star Electric Fuse Works, Wilkes Barre, Pa.
Stark & Co., Dry Goods, New York City.
William H. Starr, Harness, Decatur, Ill.
Star Headlight Co., Rochester, N. Y.
Star Shirt Co., New York City.
Star Well Drilling Machine Co., Akron, Ohio.
Star Well Drilling Co., New York City.
Stauffer Eshlemann & Co., New Orleans, La.
Steacy-Schmidt Manufacturing Co., Spillway-gate Machines, York, Pa.
C. S. Stearns, Shoes, Boston, Mass.
J. Steckler Seed Co., New Orleans, La.
A. Steinhart & Bros., Leather Goods, N. Y. C.
Stein, Hirsh & Co., Laundry Starch, New York City.
Stempel Fire Extinguisher Mfg. Co., St. Louis, Mo.
Stephen-Adamson Mfg. Co., Conveying Machines, Aurora, Ill.
Sterling Blower & Pipe Mfg. Co., Hartford, Conn.
Sterling Electric Motor Co., Dayton, Ohio.
Sterling Engraving Co., New York City.
Sterling Machine Co., Rochester, N. Y.
Sterling Wheelbarrow Co., Steel Wheelbarrows, N.Y.
C. Stern & Mayer, Wearing Apparel, N. Y. C.

Stern Bros., Dry Goods, New York City.
L. L. Stern, Supplies, Norfolk, Va.
John B. Stetson Co., Philadelphia, Pa.
Stetson Shoe Co., S. Weymouth, Mass.
Stevenson Bros. & Co., Oils, Philadelphia, Pa.
The Stevenson Co., Ice and Refrigerating Machinery, Chester, Pa.
Stewart Dickson & Co., Packing, New York City.
Jacques Stisch, Vegetables and Fruit, New Orleans.
J. & J. W. Stolts, Caskets, New York City.
Stonega Coke & Coal Co., Philadelphia, Pa.
Storer Motor Car Co., Freeport, Ill.
Eben Storer, Paper, New York City.
H. M. Storms, Stationery, New York City.
Storrs, Schaefer & Co., Uniforms, Cincinnati, Ohio.
Straus Bascule Bridge Co., Designed Lift Span, Chicago, Ill.
L. Strauss & Son, Bath Fixtures, New York City.
Strawbridge & Clothier, Dry Goods, Philadelphia, Pa.
J. S. Stringham, Detroit, Mich.
Strobel & Wilkins, Toys, New York City.
Studebaker Corporation, Vehicles of all Kinds, South Bend, Ind.
G. L. Stuebner Iron Works, Buckets, Long Island C.
John Stumpf, Ant Paper, Greta, La.
B. F. Sturtevant Co., Engravers, New York City.
B. F. Sturtevant Co., Generators, Hyde Park, Mass.
Suderman & Dolson, General Sup., Galveston, Texas.
Sugar Pine Lumber Co., San Francisco, Cal.
J. W. Sullivan & Co., Marine Engine Builders, N.Y.C.
Sullivan Machinery Co., Chicago, Ill.
Sullivan Machinery, New York City.
Sullivan Metallic Packing Co., Chicago, Ill.
Sulzberger & Sons Co., Packers, Chicago, Ill.
Sun Co., Petroleum Products, Philadelphia, Pa.
Sunlit Fruit Co., W. Berkeley, Cal.
The Superior Machine Co., Saw Blades, Chicago, Ill.
Suplee, Reeve, Whiting Co., Umbrellas, N. Y. C.
Surburg & Co., Cigarette Papers, New York City.
Surpless, Dunn & Co., General Supplies, N. Y. C.
Susquehanna Coal Co., Philadelphia, Pa.
Sussfeld, Lorsh & Co., Optical Goods, N. Y. C.
Sussman, Wormser, Co., San Francisco, Cal.
Sutphen & Myer, Plate Glass, New York City.
E. Sutro & Son, Clothing, Philadelphia, Pa.
G. T. Sutterly Co., Cuspidors, Philadelphia, Pa.
Swaffield Murphy Comsn. Co., Straw, New Orleans.
H. C. Swain & Co., New York City.
H. C. Swain & Sons, Household Furnishings, New York City.
Swan & Finch, Lubricating Oils, New York City.
Nathan Sweitzeer, New York City.
Swenson Valve Co., Decorah, Ia.
Swift & Co., Packers, Chicago, Ill.
Swindell Bros., Glass, Baltimore, Md.
T. H. Symington Co., Iron Castings, Baltimore, Md.
Syndicate Trading Co., Wearing Apparel, New York.

T

Tabor Mfg. Co., Machines, Saws and Grinders, Philadelphia, Pa.
Charles J. Tagliabue Mfg. Co., Thermometers, N. Y.
J. B. Taltavall, Publisher, New York City.
Tasker & Strawbridge, Philadelphia, Pa.
Taunton-New Bedford Copper Co., New Bedford, Mass.
George H. Tay Co., San Francisco, Cal.
W. P. Taylor Co., Buffalo, N. Y.
N. & G. Taylor, Tin, Philadelphia, Pa.
W. P. Taylor Co., Boxes, Buffalo, N. Y.
S. C. Taylor Chain Co., Chicago, Ill.
Taylor Instrument Co., Rochester, N. Y.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Taylor Nurse Bed Co., New York City.
H. R. Teepe, Mfrs., Agents, New York City.
Tefft-Weller & Co., Millinery Supplies, N. Y. C.
Tedcastle & Co., Shoes, Boston, Mass.
Telescope Cot Bed Co., New York City.
C. K. Tenny & Co., Straw Hats, New York City.
Tenny, Hills & Hall, Hats, New York City.
Terre Haute Carriage & Buggy Co., Terre Haute, Ind.
F. B. Tharns, Tents, New York City.
M. H. Thatcher, Ancon, Panama.
Theobald & Oppenheimer Co., Cigars, Phila., Pa.
Thermoid Rubber Co., Packing, Hose, Trenton, N.J.
The Charles Taylor's Sons Co., Brick & Fire Clay, Cincinnati, Ohio.
The Texas Co., Petroleum Oils, New York City.
The Thew Automatic Shovel Co., Lorain, Ohio.
The Timekeeper Co., Watches, Chicago, Ill.
The Tower Mfg. & Novelty Co., Stationery, N.Y.C.
The Touraine Co., Boston, Mass.
The Trenton Iron Co., Trenton, N. J.
J. R. Thomas, Tents, New York City.
Seth Thomas Clock Co., New York City.
W. E. Thomas, Forage, Leavenworth, Kans.
L. H. Thomas Co., Paste, Chicago, Ill.
G. A. Thomas Machine Co., Belleville, N. J.
G. H. A. Thomas Co., Lumber, New Orleans, La.
Arthur H. Thomas Co., Light Excluding Apparatus, Philadelphia, Pa.
Thomas & Betts Co., Elec. Goods, New York City.
Thomas Laughlin Co., Wood Tackle Blocks, Portland, Me.
Thonet Bros., New York City.
F. R. Thorns, New York City.
J. M. Thorburn & Co., Comsn. Merch., New York.
Three-In-One Oil Co., New York City.
O. & W. Thum Co., Fly Paper, Grand Rapids, Mich.
Tidewater Press, Stationery, New York City.
Tietjen & Lang D. D. Co., Hoboken, N. J.
Tiffany & Co., Jewelers, New York City.
George Tileston Milling Co., St. Cloud, Minn.
Walter B. Timms, Lye, Soap, New York City.
Tingue, Brown & Co., Flts., New York City.
Tital Steel Castings Co., Screen Plates, Newark, N. J.

Toledo Bridge & Crane Co., Structural Steel Works, Toledo, Ohio.
Topping Bros., Glass Instruments, New York City.
W. E. Torrens & Co., Straw Hats, New York City.
J. R. Torry Razor Co., Worcester, Mass.
D. A. Tower, New York City.
A. J. Towers Co., Slickers, New York City.
Tower & Lyon Co., Hardware Specialties, N. Y. C.
Towns & James, Druggists, Brooklyn, N. Y.
Travers Bros. Co., Cord, New York City.
Walter L. Treat, Reamers, New York City.
John Tregeser, Copper Ware, New York City.
Trenton Rubber Manufacturing Co., Trenton, N. J.
Trojan Powder Co., New York City.
Tropenas Converter Co., Converters, New York City.
Troy Laundry Machinery Co., New York City.
True Shape Hosiery Co., Philadelphia, Pa.
Trussed Concrete Steel Co., Detroit, Mich.
Tucker Tool & Machine Co., New York City.
Tucker & Carter Rope Co., Cord, New York City.
J. Spencer Turner Co., Canvas, New York City.
R. C. Turner, Insurance, New York City.
Tuttle & Bailey Manufacturing Co., New York.
Tutwiler Coal & Coke Co., New Orleans, La.
W. S. Tyler Co., Copper Wire Netting, Cleveland, Ohio.
Tyler Tube & Pipe Co., New York City.

U

Bernard Ullman, Dry Goods, New York City.
Underwood Typewriter Company, New York City.
Union Bag & Paper Co., New York City.
Union Carbide Sales Co., New York City.
Union Condensed Milk Co., New York City.
Union Draft Gear Co., Chicago, Ill.
Union Drawn Steel Co., New York City.
Union Fiber Co., Winona, Minn.
Union Foundry Co., Anniston, Ala.
Union Foundry & Machine Co., Pittsburgh, Pa.
Union Iron Works, Floating Caisson Dams, San Francisco, Cal.
Union Oil Co., Road Oil, California.
Union Petroleum Co., Philadelphia, Pa.
Union Selling Co., New York City.
Union Spring & Manufacturing Co., New York City.
Union Steel Castings Co., Pittsburgh, Pa.
Union Stove Works, New York City.
The Union Switch & Signal Co., New York City and Swissdale, Pa.
Union Tool Co., Torrance, Cal.
United Building Material Co., Giant Portland Cement, New York City.
United Cigar Stores Co., New York City.
United Engineering & Foundry Co., Chain Operating Machinery, Pittsburgh, Pa.
United & Globe Rubber Mfg. Co., Wash., D. C.
United Lead Co., New York City.
United Produce Co., New York City.
United Shirt & Cloth Co., New York City.
United Shoe Machinery Co., Boston, Mass.
United Shirt & Collar Co., New York City.
United States Envelope Co., Rockville, Conn.
United States Graphite Co., Saginaw, Mich.
United States Steel Rails Co., New York City.
Universal Supply Co., Stationery, New York City.
Universal Trading Co., Tar, Chloride of Lime, etc., New York City.
The George Urban Milling Co., New York City.
U. S. Cast Iron & Foundry Co., New York City.
U. S. Cast Iron Pipe & Foundry Co., Phila., Pa.
U. S. Electrical Tool Co., Cincinnati, Ohio.
U. S. Gutta Percha Paint Co., Providence, R. I.
U. S. Metallic Packing Co., Philadelphia, Pa.
U. S. Mop Co., Toledo, Ohio.
U. S. Paper Exp. Assn., New York City.
U. S. Ray Manufacturing Co., San Francisco, Cal.
U. S. Shipping Co., New York City.
U. S. Steel Co., New York City.
U. S. Steel Products Exports Co., New York City.
U. S. Tie Plug Co., Saginaw, Mich.

V

Valley Iron Works, Inc., Williamsport, Pa
Valk & Murdoch Iron Works, Charleston, N. C.
Valves Sales Co., Valves, La Crosse, Wis.
Van Camp's Packing Co., New York City.
Van Bibber Roller Co., Cincinnati, Ohio.
Van Houton & Zwon, Chocolate, Cocoa, N. Y. C.
Peter Van Schaack & Sons, Sponges, Chicago, Ill.
J. B. Van Seiver Co., Office Furniture, Camden, N. J.
F. R. & F. J. Vericon, Brooklyn, N. Y.
Vermilye & Power, Gongs, Lights, Pumps, N. Y. C.
The Vilter Mfg. Co., Milwaukee, Wis.
Harry Vissering & Co., Valves, etc., Chicago, Ill.
L. Vogelstein & Co., Tin and Copper, New York.
Voorhees Rubber Mfg. Co., Jersey City, N. J.
Vulcan Iron Works, Wilkes-Barre, Pa.
Vulcan Rail & Construction Co., Brooklyn, N. Y.

W

The Waage Electric Co., Chicago, Ill.
Waclark Wire Co., New York City.
H. A. Wagner, Lebanon, Pa.
Walker Electric Co., New York City.
John W. Walker, Packer, New York City.
Wall Rope Works, Manila Rope, New York City.
John F. Wallace, New York City.
D. S. Walton & Co., Paper, New York City.
John Wanamaker, Dry Goods, New York City.
Horace Ward, Handles, Washington, D. C.
Warren Wood, Wood Drill Works, Paterson, N. J.
Warnock Co., Hats, New York City.
Washburn-Crosby Co., Flour, Minneapolis, Minn.

Washington Rubber Co., Washington, D. C.
Martha Washington Candy Co., Baltimore, Md.
Waterbury Co., Manila Rope, New York City.
Waterman & Co., Vegetables, New York City.
Watkins Laundry Machine Co., New York City.
John B. Watkins, Dating Stamps, New York City.
J. Y. Watkins & Son, Hotel Supplies, New York.
Wawyer Boot & Shoe Co., Bangor, Maine.
J. H. Weaver & Co., Coal, Philadelphia, Pa.
Webb Motor Fire Apparatus Co., St. Louis, Mo. and Allentown, Pa.
Elisha Webb & Sons Co., Cooking Stoves, Phila., Pa.
James A. Webb, Chemicals, New York City.
F. Weber & Co., Pencils, Philadelphia, Pa.
W. C. Weber, Jeweler, New York City.
Webster Refining Co., Jennings, La.
A. A. Weeks-Hoskins Co., Office Fixtures & Sup., N.Y.
J. H. Weil & Co., Jacks, German Silver Thumbs, Philadelphia, Pa.
Weller Mfg. Co., Friction Clutch Pulley, Chicago.
Welch Grape Juice Co., New York City.
Wellington, Sears & Co., Canvas, Boston, Mass.
Robert Werk & Co., Mattresses and Pillows, New Orleans, La.
Werner & Pfleiderer, Conveyers, Saginaw, Mich.
Wertheimer Swarts Shoe Co., St. Louis, Mo.
West Coast Trading Co., Wearing Apparel, N. Y. C.
West Disinfectant Co., New York City.
West End Rolling Mill Co., Lebanon, Pa.
West India Oil Co., Kero. and Gasoline, N. Y. C.
West India Oil Co., Road Oil, St. Louis, Mo.
The West Pascagoula Creosoting Works, W. Pascagoula, Miss.
Western Clock Co., New York City.
Western Electric Co., New York City.
Western Electric Co., Cable, New York City.
Western Electric Instrument Co., Newark, N. J.
Western Railway Equipment Co., St. Louis, Mo.
Western Steel Car & Foundry Co., Chicago, Ill.
Western Tube Co., Ties, Kewanee, Ill.
Western Wheeled Scraper Co., Aurora, Ill.
Paul Westfall, Drugs, New York City.
Westinghouse Air Brake Co., Pittsburgh, Pa., and Wilmerding, Pa.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Westinghouse Machine Co., E. Pittsburgh, Pa.
Wetherill Bros., Machine Co., Gears, Ball Joints, etc., Chester, Pa.
J. R. Wettstein, White Lead, New York City.
William Wharton, Jr., & Co., Iron and Steel, Phila.
C. H. Wheeler Manufacturing Co., Philadelphia, Pa.
Morris Wheeler & Co., Philadelphia, Pa.
Wheeling Corrugating Co., New York City.
Wheeling Mold & Foundry Co., Wheeling, W. Va.
Wheelock, Lovejoy & Co., New York City.
Whelan, Davit & Lane & De Groot Co., Metallic Life Boats, New York City.
Whelock Reinforced Cork Boat Co., New York.
Whital, Tatum Co., Druggists, New York.
White Enameling Refrigerating Co., St. Paul, Minn.
White Furniture Co., Mebane, N. C.
The White Tar Co., Lime, New York City.
White, Van Glahn & Co., Hardware, New York City.
Whiting Foundry Equipment Co., Harvey, Ill.
C. W. Whitman Co., Dry Goods, New York City.
The Whitmore Mfg. Co., Oils, Cleveland, Ohio.
Whitney Supply Co., Belting, New Orleans, La.
Wichert & Gardiner, Shoes, Brooklyn, N. Y.
Wick Narrow Fabric Co., Philadelphia, Pa.
Wickwire Bros., Inc., Wire Cloth, Cortland, N. Y.
Wiebash & Hilger, Hardware, New York City.
Wier Frog Co., Cincinnati, Ohio.
W. J. Wilcox Lard & Refining Co., New York City.
Will & Baumer, Candles, New York City.
William-Seaver-Morgan Co., Concrete Buckets, Cleveland, Ohio.
A. A. Williams Shoe Co., Hollister, Mass.
Arthur P. Williams, New York City.
Williams Brown & Earle, Inc., Philadelphia, Pa.
J. B. Williams, General Supplies, New York City.
I. T. Williams & Sons, Lumber, New York City.
Williams & Wells Co., Steel, New York City.
Wms. White & Co., Coal Chute Pockets, Moline, Ill.
F. P. Wilkinson, Hardware, New York City.
Williamson Bros. Co., Philadelphia, Pa.
Balfour Williamson & Co., General Sup., New York.
Williamsport Wire Rope Co., Williamsport, Pa.
C. G. Willoughby, Photo Supplies, New York City.
Wilmington Malleable Iron Co., Wilmington, Del.
Wilson Bros., Jewelry, Brooklyn, N. Y.
Wilson Distilling Co., Mineral Water, New York.
Wilson, Adams & Co., New York City.
Wilson-Masculen Co., Electro Pyro Meters, N. Y. C.
Wilson & Bradbury, Blankets, Philadelphia, Pa.
William A. Wilson, New York City.
James B. Wilson Co., Stationery, New York City.
Jas. G. Wilson Mfg. Co., Shutters, New York City.
Winchester Repeating Arms Co., New York City.
Wincroft Stove Works, Middletown, Pa.
Wingarten Bros., Corsets, New York City.
D. P. Winne Co., Rope, New York City.
The Francis T. Witte Hardware Co., New York.
Rudolph Wirlitzer, Musical Instrus., Cincinnati, O.
Wolfs, Sayer & Heller, New York City.
Wolverine Motor Works, Inc., Bridgeport, Conn.
Wood Drill Works, Rock Drills, Paterson, N. J.
The Woodhouse Mfg. Co., Hand Grenades, N. Y. C.
George Wood & Sons, Dry Goods, New York City.
R. D. Wood & Co., Iron Pumps, Philadelphia, Pa.
E. B. Woodward, General Supplies, N. Y. C.
Woodward & Lothrop, Inc., Dry Goods, Wash., D.C.
Woodward, Wight & Co., Ltd., Com. Merch., New Orleans, La.
Woolen Distilling Co., Peoria, Ill.
Work & Co., Straw Hats, New York City.
James R. Wotherspoon, Galvanized Night Soil Buckets, Philadelphia, Pa.
Wouldham Cement Co., Ltd., New York City.
E. T. Wright & Co., Shoes, Rockland, Mass.
Wright & Ditson, Sporting Goods, New York City.

William Wrigley, Jr., Chewing Gum, Chicago, Ill.
Wrought Washer Mfg. Co., Milwaukee, Wis.
Wycoff Pipe & Creosoting Co., Inc., Stamford, Conn.
Wycoff, Seamans & Benedict, New York City.
D. Wynant, Comn. Merchant, New York City.
Wynkoop, Hallenbeck, Crawford Co., Printers, New York City.

Y

Julian L. Yale & Co., Wool Waste, Chicago, Ill.
The Yale & Towne Mfg. Co., Locks, New York.
Yawman & Erbe Mfg. Co., Office Sup. Wash., D. C.
Joseph Yeska, Clothing, New York City.
N. D. Yont & Co., Steel, Pittsburgh, Pa.
York Export & Commission Co., New York City.
York Mfg. Co., Chemicals, Ice Machines, N. Y. C.
York Safe & Lock Co., Safes, York, Pa.
A. C. Young & Co., Fish Packers, Richmond, Va.
Y. M. C. A. Library Agency, B. P. Bartlette, Mgr., Le Roy, N. Y.
Young & Selden Co., Stationers, Baltimore, Md.
A. P. Youngblood, Flour, New York City.
The Youngstown Sheet & Tube Co., Youngstown, O.

Z

Zabriskie & Co., Flour, New York City.
A. Zereges Sons, Macaroni, New York City.
Zimmern & Levi, Ties, New York City.

BIOGRAPHICAL

BIOGRAPHICAL

ABBOT, HENRY LARCOM, Int. bd. consulting eng'rs., Panama Canal; born Beverly, Mass., Aug. 13, 1831; ed. Boston Latin School, 1846-50; grad. West Point, 1854; L.L.D. Harvard; Designed system of submarine defense adopted by U. S.; Retired from corps of eng'rs. U. S. A., 1895; Member Tech. Comm. and consulting eng'r. New Panama Canal Co., 1897-1904; Made experiments to solve problems of the Panama Canal.

ACEVEDO, RAMON F., secy. of Fomento and Public Works, Republic of Panama; ed. in Bogotá; interested in commission business and commercial interests in Costa Rica for many years; apptd. Secy. of Finance by Pres. Mendoza; apptd. Secy. State by Pres. Arosemena.

ACHER, A. H., capt., Corps of Engrs., U. S. A.; asst. engr. Div. Fortifications, The Panama Canal, since 1912; born June 6, 1885; grad. U. S. Mil. Acad.; 2d lt. eng., June 11, 1909; 1st lt. Feb. 27, 1912; capt. 1915; add. Culebra, Canal Zone.

ADAMS, JAMES H., born Miss. 1877; went to Isthmus 1907; genl. foreman construction Bas Obispo; supervisor lock excavation Gatun; in charge construction Colon harbor breakwater, 1911.

ADAMSON, WILLIAM C., Member of Congress from Georgia; chmn. Com. on Interstate and Foreign Commerce; in charge of Panama Canal Act of 1912; born Bowdon, Ga., Aug. 13, 1854; grad. Bowdon College 1874 (A.M. Bowdon); read law in office of Hon. Sampson W. Harris; admitted to bar Oct. 1876; judge city court Carrolton, Ga., 1885–89; pres. elector 1892; elected to 55th, 56th, 57th, 58th, 59th, 60th, 61st, 62nd, 63rd, 64th Congresses.

ALEXANDER, WILLIAM H., apptd. asst. supt. transportation, Cent. Div., Canal Zone, July 1, 1908.

AMADOR, MANUEL, first Pres. Republic of Panama; active in revolutionary movement against Colombia; deceased.

AMMEN, DANIEL, Rear Admiral, U. S. N.; born in Brown County, Ohio, May 15, 1820; entered the the navy as a midshipman in 1836; in 1849 promoted to lieutenant; commissioned captain in 1866. Later was made a commodore, and in 1874 commissioned rear admiral. In that year was appointed with General A. A. Humphreys to make surveys for a ship canal through the Isthmus of Panama, and also through Nicaragua. Three years later the commission made an elaborate report, having caused four routes to be surveyed. Died Washington, D. C., July 11, 1898.

ANDREVE, GUILLERMO, secy. Pub. Educ., Republic of Panama; owner of the newspaper *La Prensa;* writer of textbooks; founder of first ill. review of Panama, the *Herald.*

ANDREWS, PHILIP, Capt. U. S. N.; born New York Mar. 31, 1866; ap. naval acad. from N. J., 1882; chief Bu. Nav., rank of rear adm., under Secy. Meyer; com. *Maryland*; commandant Yerba Buena training sta., Cal.

ANGEL, LAURENCE, Capt. U. S. A., 1st lt. police dept., Canal Zone in 1905; born Sept. 20, 1873; apptd. 2d lt., P. R. P. R. Inf. Mar. 25, 1902; 1st lt. Jan. 31, 1903; hon. disc. June 30, 1904; apptd. 1st lt. P. R. P. R. Inf. July 1, 1904; capt. Nov. 20, 1906; add. San Juan. P. R.

ANNETT, C. F., ch. bu. communications, Canal Zone, 1905.

ARANGO, JOSÉ AGUSTIN; Minister of Foreign Relations, Panama; prominent in securing independence of Panama; born Panama City, Feb. 24, 1841; died May, 1909.

ARANGO, RICARDO MANUEL, civ. engr.; ch. engr., Repub. of Panama; born Panama City; grad. Rensselaer Poly. Inst.; returned to Panama as asst. engr. Panama R. R. Co.; apptd. ch. engr., Panama Water Works; apptd. Minister to London, later apptd. consulting engr., Panama Water Works; apptd. div. eng., meteorology and river hydraulics; married Maria Lewis, 1899; add. Panama City, Panama.

ARIAS, RICARDO; Fiscal Commr. to U. S.; born May 2, 1852; son of Ramon Arias Perez and Manuela Clotilde Feraud; grad. Commer's Com. Col. Boston; supported Hay-Herran Canal treaty; negotiated monetary convention with Canal Zone and superintended issue Republic's silver coinage; received the $10,000,000, price of the canal concession, as fiscal commr.; apptd. by Pres. Amador Secy. of Government and Foreign Affairs; was candidate for pres., but resigned.

ARIAS, TOMÁS, supported movement for independence of Panama, and first Secy. of Government and Foreign Relations of Panama; born Panama City, Dec. 29, 1855; ed. Jamaica; apptd. deputy to Legis. Assmbly. 1883; mem. Nat. Cong. at Bogotá, 1888; sub-secy. of gov. to Gov. Aycardi; apptd. secy. to government, 1890; apptd. senator, 1896; apptd. administrator nat. finances; deputy to Legis. Assembly, 1906–8.

ARJONA, ARISTIDES; given chg. of the Gen. Treasury on independence of Panama; later Secy. of State and Minister of Foreign Affairs under Pres. Amador; apptd. Jus. Supreme Court in administration of Pres. Obaldia; under prov. pres. of Rodolfo Chiari was secy. of Foreign Affairs; during administration of Pres. Porras was atty. gen. and later jus. of the Supreme Court.

AROSEMENA, PABLO, ex-Pres. of Panama; born in Panama; ed. schools there, then went to Bogotá, Colombia, taking up legal studies; grad. as lawyer at age of 17; secy. of Supreme Court; served several terms as rep. and senator for Panama; when Panama belonged to Colombia he was pres. of sovereign state of Panama; apptd. secy. to Colombian Legation in England and France, and during war between Chile and Peru was Minister to Chile, Peru and Bolivia; deputy in Panama Assembly; elected first vice-pres. of Panama.

AROSEMENA, C. C., secy. of Commn. for arbitration canal treaty, 1903; born Panama City; ed. Pitkins Eng. School, Springfield, Mass., and Williston Sem., Easthampton, Mass.; grad. Rensselaer Poly. Inst., Troy, N. Y., as civ. engr., 1891; employed by Panama Tramway Co., 1893–4; with Caribbean Manganese Co., 1894–6; in 1903 was one of the champions for the movement which resulted in the independence of Panama; asst. secy. of Foreign Affairs and later secy. Panama Legation at Washington; apptd. Minister to Washington; signed Root-Arosemena treaty; apptd. secy. of Fomento, 1911.

ASHBURN, PERCY M., maj., med. corps., U. S. A., gen. inspr., health dept., The Panama Canal; born June 28, 1872; apptd. asst. surg., Dec. 12, 1898; capt. asst. surg., Dec. 12, 1903; maj., June 24, 1908; (M. D. Jefferson Coll., 1893); add. Ancon, Canal Zone.

ASPINWALL, WILLIAM H., merchant and capitalist; born in New York City, Dec. 16, 1807. Educated at private schools. Entered mercantile house of his uncles, and became a partner in the business in 1832. Firm soon became the most important shipping firm in the U. S. In 1849 government awarded him contract for establishment of mail steamship line from San Francisco to Panama and he established Pacific Mail Steamship Co., retiring from the mercantile firm. He conceived the idea of building a railroad across the Isthmus, and associated with him in the enterprise Henry Chauncey, capitalist of New York, and John Loyd Stephens, an explorer and engineer. They obtained from the government of New Granada a contract and concession for proposed road, which was completed in 1855. The city of Aspinwall, the Atlantic terminus of the road, was named for him. In 1856 he retired from active business. Died in New York City, January 18, 1873.

AUSTIN, FREDERIC C., pres. Municipal Engineering and Contracting Co., and F. C. Austin Drainage Excavator Co., Chicago; supplied ditch and concrete mixing machinery for the Panama Canal; born at Skaneateles, N. Y., June 2, 1853; son of Dorr and Marietta Austin; ed. Skaneateles Acad.; moved to Chicago 1869, taking position as bookkeeper with his uncle, Henry W. Austin; in 1872 went to Kansas City, Mo., traveling through the West selling farm machinery; a pioneer in the manufacture of road machinery; originally of Gould & Austin Mfg. Co., afterward for many years of the F. C. Austin Mfg. Co., selling his interest in 1902, and built up business of his own; married to Anna B. Ogden (nee Barker) in May, 1887; clubs—Chicago, Chicago Athletic, South Shore Country, Western Engineering Soc., (Chicago), Circumnavigators (New York); add. Railway Exchange Bldg., Chicago, Ill.

B

BAILY, JOHN, English engineer; in 1826–36 surveyed route for Nicaragua canal.

BALBOA, VASCO NUÑEZ de; born at Jerez de los Caballeros, Estremadura, Spain, about 1475. Little or nothing is known of his early life. In 1509 he accompanied Bastidas in his voyage of discovery, in what was known as the famous Ojeda expedition, sailing from Santo Domingo. Balboa became a planter, and was heavily involved in debt. When Enciso sailed in 1510 to join Ojeda he found Balboa a stowaway in his vessel. Balboa persuaded Enciso to sail for the Isthmus of Darien, where they founded Sta. Maria de la Antigua del Darien. There Balboa plotted against Enciso, finally accomplishing his overthrow. Enciso sailed for Spain while Balboa remained and conquered the surrounding territory, securing much booty. On Sept. 1, 1513, he began a march across the Isthmus in search of the South Sea. He had with him 190 Spaniards, among whom was Francisco Pizarro, afterward conqueror of Peru. On Sept. 25, he discovered the Pacific Ocean, and next day took possession of the ocean and all the lands bordering it in the name of the Spanish king and queen. His enemies plotted against him in Spain, and Pedro Arias de Ávila was sent to Panama as gov. In 1517 he accused Balboa of attempting to incite an insurrection, and caused him to be executed at Acla.

BARBER, CHARLES W. major U. S. A.; chief div. police and prisons, the Panama Canal; born Gloucester County, N. J., Sept. 22, 1872; apptd. 2nd lieut. U. S. Vols. Spanish-American War; promoted to 1st lieut. and capt.; commissioned 2nd lieut. in regular army 1901; promoted to 1st lieut. 1901, capt. 1911, maj. 1915; detailed to duty on Isthmus 1909, assigned to div. police and prisons; apptd. ch. div. 1912. Is member Military Order of Carabao, Army and Navy Club, Wash., D. C., and Army and Navy Club, Manila; add. Ancon, Canal Zone.

BARD, THOMAS R., ex-U. S. Senator, introduced amendment providing for tolls exemption for coastwise ships, which was dropped at the time, the consensus of opinion in the Senate being that the Hay-Pauncefote treaty permitted this; born Chambersburg, Pa., Dec. 8, 1841; son of Robert M. and Elizabeth S. (Little) Bard; grad. Chambersburg Acad. at 18 at head of class; studied law; married Mary B. Gerberding of San Francisco, Apr. 17, 1876; large interests in lands and development of oil industry in Cal.; U. S. Senator 1900–5; died Hueneme, Cal., Mar. 5, 1915.

BARRETT, JOHN, diplomatist; born Grafton, Vt., Nov. 28, 1866; son of Charles and Caroline (Sanford); grad. Worcester Acad. and Dartmouth Col. (LL.D. Nat. Univ. Bogotá and Tulane Univ.); unmarried; newspaper work San Francisco, Tacoma, Seattle, ed. *Telegram*, Portland; U. S. Minister to Siam 1894–98; made diplomatic investigations Japan, Philippines, Korea, Siberia, and India; del. Pan-Am. conf., Mexico, 1902; U. S. Minister to Argentina 1903–04; to Panama 1904–05; to Colombia 1905–06; director-gen. Pan-Am. Union since 1907; add. Pan-Am. Union, Wash., D. C.

BASCOM, JOSEPH, D., secy. treas. Broderick & Bascom Rope Co., St. Louis, Mo.; born St. Louis, Mo., July 2, 1849; son of Jonathan Dayton and Francis Ann Bascom; married Mary Frederick, at St. Louis, May 31, 1877; clubs—Commer-

cial, St. Louis, Racquet, Mercantile, Country (St. Louis); add. 809 N. Main St., St. Louis, Mo.

BASTIDAS, RODRIGO de, Spanish navigator; born in Spain about 1460; organized expedition and sailed for America in 1502; discovered the Isthmus of Panama; his expedition was prior to that of Ojeda, who later coasted the line of South and Central America, and made a settlement on the Isthmus. Was wounded in a revolt and died in Santo Domingo.

BATES, WILLIAM H., apptd. supt of steam-shovel repairs, Cent. div., Dec. 1, 1908.

BAXTER, JOHN K., chief, div. civil affairs, The Panama Canal; add. Ancon, Canal Zone.

BEAM, WALTER IRVIN, b. Pa.; grad. Girard Col.; went to Isthmus Oct. 1905; apptd. Chief Clerk Central div. Canal Zone.

BEAMAN, DON H., gen. storekeeper, Empire, Canal Zone; born Wash. Co., Tex., April 13, 1880; ed. pub. schools Texas; grad. law Univ. of Texas, 1900; Vol. Span.-Am. War, retired for injuries incidental to service and apptd. post qmr. sergt. U. S. A., and assigned to duty Am. Leg. Peking; resigned 1906 and employed by Bradstreet Com. Agency; resigned 1907 to enter Sou. Ry., apptd. Isthmian Canal Comn. 1908; add. Empire, Canal Zone.

BECK, EDGAR P., treasurer, Canal Zone; b. Saginaw, Mich.; pub. sch. ed; entered U. S. army Jan. 1895; served 3 years; went to Isthmus 1905 as accountant; apptd. asst. treasurer 1908; apptd. treasurer 1908.

BELDING, W. M., apptd. master bldr., div. of bldg. constrn., 1907.

BELL, WILLIAM H., surg., U. S. N., supt. hosp. Ancon, Canal Zone, 1910–13; born Milwaukee, Wis., Mar. 3, 1873; ed. pub. schools; grad. Univ. of Pa., 1897; apptd. Med. Corps, U. S. N., Sept. 16, 1898; senior surg. with battalion of marines on duty at Camp Elliott at Empire, 1904–5; served on U. S. S. *Dixie* and U. S. S. *Nevada*, and in Bu. Med. & Surgery; married Eleanor Yorke Parker, of Phila., Oct. 13, 1902; add. Navy Yard, Phila., Pa.

BENSON, ERNEST S., apptd. gen. auditor, Washington Off., Isthmian Canal Commn., Apr. 27, 1905.

BERGIN, RALPH WILLIAM, Receiving and Forwarding Agent and Port Capt. P. R. R. and S. S. Lines; b. Ky.; pub. sch. ed.; service various R. R.'s; went to Isthmus with French Co.; entered service P. R. R. in 1888.

BERTONCINI, C. F., apptd. ch. bu. map making, lithography and prints, Canal Zone, 1905.

BEYER, W. F., asst. engr., lighthouse constr., The Panama Canal; add. Ancon, Canal Zone.

BIERD, W. G., apptd. gen. supt. and later gen. mgr., P. R. R., Canal Zone, 1907.

BISHOP, JOSEPH B., secy. The Panama Canal since Sept. 1, 1905; born Seekonk, Mass., Sept. 5, 1847; son of James Madison and Elzada (Balcom) Bishop; A. B., Brown Univ., 1870; married Harriet Hartwell of Providence, R. I., Dec. 14, 1872; on ed. staff N. Y. *Tribune*, 1870–83; ed. writer, N. Y. *Evening Post* 1883–00; ch. ed. staff New York *Globe*, 1900–5; clubs—Univ. (New York), Metropolitan, Chevy Chase (Washington); Author, Cheap Money Experiments, 1892; Our Political Drama, 1904; Issues of a New Epoch, 1904; The Panama Gateway, 1913; add. Ancon, Canal Zone.

BLACK, W. M., col. Corps of Engrs., U. S. A., in chg. of engineering staff, The Canal Zone, 1904; born Dec. 8, 1855; grad. U. S. Mil. Acad., apptd. 2d lt. June 15, 1877; 1st lt. March 31, 1880; capt. Dec. 31, 1886; maj. May 18, 1898; lt. col. June 26, 1905; col. July 28, 1908; add. Army Bldg., New York City.

BLACKBURN, JOSEPH CLAY STILES, civil governor, Canal Zone, Sept. 1904–Dec. 1909; mem. Isthmian Canal Comn., Apr. 1, 1907–Dec. 4, 1909; born Oct. 1, 1838, Woodford Co., Ky.; son of Edward M. and Lavinia S. Blackburn; married Therese Graham, of Danville, Ky., Feb. 10, 1858 (died 1899); 2d, Mrs. Mary E. Blackburn, of Washington, D. C., Dec. 11, 1901; A. B., Centre Col. Ky., 1857 (L.L.D.); admitted to bar 1858; practiced at Chicago 1858–60; served throughout Civil War in C. S. A.; resumed practice in Ky.; mem. Ky. Ho. of Rep., 1871–5; mem. 44th to 48th Congresses (1875–85); U. S. Senate, 1885–97 and 1901–7; mem. Isthmian Canal Commn. Apr. 1, 1907–Dec. 4, 1909; del. Dem. Nat. conventions, 1896, 1900, 1904; a leader in the free coinage movement; chmn. Dem. caucus, U. S. Senate, 1906, 1907; Pres. Interstate Club; add. Versailles, Ky.

BLACKBURN, S. E., magistrate, The Panama Canal since April 1, 1914; add. Balboa, Canal Zone.

BLOUNT, F. R., supt. railroad transportation, Panama Railroad; add. Ancon, Canal Zone.

BLUE, RUPERT, surgeon-general U. S. Public Health Service since Jan. 8, 1912; born Richmond Co., N. C., May 30, 1867; son of John G. and Annie M. Evans Blue; ed. Univ. of Va., 1889–90., Univ. of Md., 1892 (D. Sc. 1909); grad. London Sch. Tropical Medicine, 1910; Interne, 1892, asst. surg. 1903, passed asst. surg. 1907, surg. 1909; served at Cincinnati, Galveston, Charleston, S. C., San Francisco, Portland, Ore., Milwaukee, Genoa, Italy, New York, Norfolk and New Orleans; was in charge of operations in eradication of bubonic plague in San Francisco 1903–4; served through the epidemic of yellow fever in New Orleans 1905; dir. sanitation of Jamestown Expn., 1907; dir. 2d campaign against bubonic plague, San Francisco, 1907–8; add. U. S. Public Health Service, Washington, D. C.

BOGGS, FRANK C., major, Corps of Engrs., U. S. A., general purchasing officer, The Panama Canal, and chief of Washington office since 1908; born Swedesboro, N. J., March 16, 1874; son of George B. and Hannah G. Boggs; married Marianne Thomson, Norristown, Pa., June, 1900; grad. Norristown (Pa.) high school, 1890; grad. U. S. Mil. Acad. 1898; Q. M. Eng. Bat., Willet's Pt., N. Y., 1898–9; local charge fortification work, Tampa, Fla., 1899–'00; student Eng. school, U. S. A., Willet's Pt. and Wash. D. C., and adjt. bat. eng., 1900–03; survey work and local charge fortification work, Phil. Islands, 1903–06; local charge construction lock and dam, Monongahela

River, and in charge eng. dis., Wheeling, W. Va., 1906–08; mem. Am. Soc. Civ. Engrs., Wash. Soc. Engrs., Nat. Geog. Soc., Army and Navy Club; res. The Westmoreland, Wash. D. C.; office The Panama Canal, Washington, D. C.

BOLICH, D. W., div. engr., Culebra constrn. div., 1907–08.

BOOTH, RUFUS K., chief accountant, The Panama Canal, since Dec. 23, 1912.

BOYD, FEDERICO, mem. Joint Land Commn.; born in City of Panama, Sept. 24, 1853; son of Archibald B. Boyd; ed. in U. S.; in 1873 married Teodolinda Briceno; was one of the leaders in the councils and in movements which resulted in secession of prov. of Panama from Colombia, and was one of two commissioners sent to Washington to conclude treaty for construction of the interoceanic canal; apptd. Minister Exterior Relations, and in 1910 2d v. p. of Panama; apptd. secy. Foreign Affairs by Pres. Arosemena; offered position Minister to Washington, but declined; add. Panama City.

BREM, WALTER, physician; grad. Johns Hopkins; went to Isthmus Aug. 12, 1905; apptd. phys. Ancon hospital; apptd. med. clinic Colon.

BRISTOW, JOSEPH LITTLE, U. S. Senator 1909–15; born Wolfe Co., Ky., July 22, 1861; ed. Baker Univ., Kan. (LL.D., 1909); married Margaret A. Hendrix, Flemingsburg, Ky., 1879; owner and ed. Salina (Kan.) *Republican-Journal;* asst. postmaster-gen., 1897–05; conducted postal investigations Cuba 1900; investigated traffic questions Panama Railroad 1905; add. Salina, Kan.

BRODERICK, JOHN J., pres., Broderick & Bascom Rope Co., St. Louis, Mo.; born Dec. 29, 1846; ed. St. Louis Univ., A. B., 1862, St. Louis Univ.; married Emelia C. Kern, St. Louis, May 8, 1878; began commercial life in hardware business; add. 805 N. Main St., St. Louis, Mo.

BROOKE, GEORGE D., mem. bd. appraisal, Canal Zone, 1904; ch. bu. mach. and equip., 1905; supt. motive power and mach., P. R. R., 1907.

BROOKE, MARK, capt., Corps of Engrs., U. S. A., representing U. S. and under instructions from atty. gen. took possession on May 4, 1904, of all the canal properties in accordance with treaty signed Nov. 18, 1903; in chg. of work and continued operations which had been conducted by the French Canal Co.; born Aug. 27, 1876; grad. U. S. Mil. Acad., apptd. 2d lt., June 12, 1902; 1st lt. Apr. 23, 1904; capt. Mar. 28, 1910; add. Manila, P. I.

BROWN, THOMAS E., Jr., assoc. jus. supreme ct., Canal Zone until June 30, 1914; born Brooklyn, N. Y.; ed. pub. schools Rochester, N. Y., grad. Brown Univ., 1890; studied law New York Law School; A. B. 1893; practiced law in New York City; apptd. dist. judge, Isthmian Canal Commn., 1907.

BRYAN, WILLIAM JENNINGS, sec. state in Wilson cabinet, 1913—; born Salem, Ill., Mar. 19, 1860; son of Silas Lillard and Mariah Elizabeth (Jennings) Bryan; ed. Ill. Col. and Union Col. of Law, Chicago; married Mary Elizabeth Baird, Perry, Ill., 1884; member 52d and 53d Cong., 1st Neb. dist.; ed. Omaha *World-Herald,* 1894–96; nom. for Pres. of U. S. by Dem. nat. conv. 1896, 1900, 1908; editor *Commoner,* Lincoln, Neb.; raised 1st reg. Neb. vol. inf. for Span.-Am. War and served as col.; author The First Battle, Under Other Flags, The Old World and Its Ways; toured world 1906; as sec. state conducted negotiations for treaty with Colombia, 1913–14.

BUDD, R., engr. constrn. and maintenance, P. R. R. 1907; ch. engr., P. R. R., 1909; resigned Sept. 21, 1909.

BULWER, Sir HENRY, British diplomat; born London, Feb. 13, 1801, died Naples May 23, 1872; brother of Lord Lytton; minister to U. S., 1849–52, and signed Clayton-Bulwer Treaty.

BUNAU–VARILLA, PHILIPPE, chief engr. Panama Canal under French régime, and first minister of Panama Republic at Washington, where he negotiated the Hay-Bunau-Varilla treaty; born Paris, France, July 26, 1859; educated École Polytechnique; commissioned capt. of engrs.; administrator of railways in Madrid; invented a dredge for digging canals and dredging harbors; planned harbor works and railways in Algeria and Tunis; became connected with Count de Lesseps and was given charge of work on Panama Canal, 1884; made many radical changes in plan of operations; active work on canal ended 1888; Minister of Panama at Washington, 1903–4; returned to France 1904; since then engaged in building railways in West Africa and improvements of navigable waterways in Roumania; wrote "Panama Le Passi," a work on Panama and the Canal.

BURR, WILLIAM HUBERT, civil engineer; apptd. April, 1899, by Pres. McKinley, mem. Isthmian Canal Comn.; apptd. 1904, by Pres. Roosevelt, mem. Isthmian Canal Comn. and mem. bd. consulting engineers since 1905; born Watertown, Conn., July 14, 1851; son of George William and Marion Foote (Scovill) Burr; C. E. Rensselaer Poly. Inst., 1872; married Caroline Kent Seelye 1876 (died 1894); 2d Gertrude Gold Shipman, 1900; began practice as civil engr. 1872; prof. rational and tech. mechanics, Rensselaer Poly. Inst. 1876–84; asst. to chief engr. and later gen. mgr. Phoenix Bridge Co., 1884–91; prof. engineering Harvard, 1892–3; prof. civil engineering Columbia, since 1893; consulting engr. to dept. pub. works, 1893–5, parks, 1895–7, of docks, 1895–7, and now dept. of bridges and bd. of water supply, New York; apptd. by Gov. Dix 1911, mem. advisory bd. of engineers for construction of Barge Canal by State of New York; awarded first place in nat. competition, 1900, for proposed memorial bridge across Potomac at Washington; mem. Am. Soc. C. E., Instn. Civ. Engrs. of Great Britain, etc.; author, The Stresses in Bridge and Roof Trusses, 1881; Elasticity and Resistance of the Materials of Engineering, 1883; Ancient and Modern Engineering and the Isthmian Canal, 1902; The Graphic Method by Influence Lines for Bridge and Roof Computation (with M. S. Falk), 1905; Suspension Bridges, Arch Ribs and Cantilevers, 1913; add. Columbia Univ., New York.

BURTT, A. M., apptd. supervising architect, Canal Zone, 1905.

BUTLER, HENRY V., lt. comdr., U. S. N., capt. of the port, The Panama Canal; born March 9, 1874; grad. U. S. Nav. Acad.; add. Balboa, Canal Zone.

C

CALDWELL, BERT W., phys.; born Illinois; went to Isthmus 1905; apptd. dist. phys. Bas Obisbo; supt. Santo Tomas Hospital, 1911.

CALVO, RAOUL J., municipal treasurer, Panama; born Penonomá; ed. schools Balboa, leaving when 17 to enter business; supported Obaldia party in 1908 and apptd. mem. Consejo Electoral; clubs—Union, International; add. Ancon, Canal Zone.

CAMPBELL, A. I., res. engr., 1st dist. dept. of constrn. and engrg., Corozal, April 1, 1909–Dec. 27, 1909.

CAREW, FRANK J., supt., sou. div., permanent buildings div., The Panama Canal, since Aug. 19, 1913.

CARPENTER, C. L., asst. engr., Culebra constrn. div., 1905; apptd. res. engr., Gatun locks div., 1907.

CARTER, H. R., U. S. Health and Marine Hosp. Serv., ch. quarantine officer, Canal Zone, stationed at Ancon, 1904; dir. of hospitals, 1905.

CASAS, BARTOLOMÉ de las, a Spanish Dominican, famous as defender of the Indians; born at Seville, 1774; went to Hispaniola and accompanied Velasquez in conquest of Cuba; in 1515 went to Spain to intercede with Ferdinand in behalf of Indians; apptd. Protector of the Indians by Cardinal Ximenes, and returned to Hispaniola, 1516; returned to Spain and was received by Charles V; took Dominican habit at Santo Domingo, 1522; bishop of Chiapas, Mexico; published a history of the Indies; died Madrid, July, 1566.

CERON, ÁLVARO de SAAVEDRA, Spanish explorer, cousin of Hernan Cortés and follower of Balboa; suggested plans in 1529 for a canal across Isthmus of Panama.

CHIARI, RODOLFO, 1st v. p. Repub. of Panama, sub.-secy. finance during administration Pres. Obaldia, later mgr., govt. bank City of Panama; born Aguadulce, prov. Cocle; ed. pub. schools; municipal treas. Colon; rep. prov. Cocle first nat. conv.; municipal treas. dist. Panama; tendered but declined secy. finance by Pres. Mendoza; elec. 3d designado, 1910.

CHOATE, JOSEPH HODGES, diplomatist and lawyer; born Salem, Mass., Jan. 24, 1832; ed. Harvard; (LL.D. Amherst, Harvard, Cambridge, Edinburgh, Yale, St. Andrew's, Glasgow, Williams, Pa., Union, McGill; D. C. L. Oxford); married Carolina Dutcher Sterling, 1861; mem. com. of 70 that broke up Tweed ring, 1871; ambass. to Great Brit. 1899–05, and assisted in negotiation of 1st and 2d Hay-Pauncefote treaties; long career as author, speaker, lawyer, and publicist; add. 60 Wall St., N. Y.

CLARK, F. C., apptd. asst. engr. operating machinery, Culebra, 1909.

CLARKE, ERNEST W., apptd. res. engr., bu. waterworks, sewers and roads, Colon, 1905.

CLAYTON, JOHN MIDDLETON, secy. of state under Taylor, Mar. 1849 to July 1850; negotiated and signed Clayton-Bulwer treaty; born Dagsboro, Del., July 24, 1796, died Dover, Del., Nov. 9, 1856; grad. Yale 1815; mem. Del. assembly, sec. state of Del., U. S. Senator 1829–36, chief justice Del. 1837–39, U. S. Senator 1845–49, 1853–56.

CLEAR, THOMAS L., collector, accounting dept., The Panama Canal, since Apr. 1, 1914; and apptd. asst. auditor, Canal Zone, Sept. 12, 1908; born Wash. D. C.; ed. Wash. schools; grad. Columbian Univ. Wash.; entered gov. service Feb. 1900; in Dept. Interior; employed by S. F. R. system, 1902–8; married Nov. 29, 1892, Laura Virginia Cronise; add., Empire, Canal Zone.

COALE, THOMAS E., pres. Thos. E. Coale Lumber Co., Phila., Pa.; shipped great quantities of lumber to the Canal; born Catonsville, Md., May 19, 1865; ed. pub. schools; married Nannie M. Coale Nov. 20, 1890; clubs—Racquet, Delaware River Club; add., Franklin Bank Bldg., Phila., Pa.

COLE, HARRY O., res. engr., 1st dist., Pacific div., The Panama Canal, since 1911, in chg. locks, dams and dry excavation; born Morgantown, W. Va.; grad. W. Va. Univ. 1898; office eng. in chg. of designs, Pacific div., 1908–09; asst. engr. 3d dist., 1909–11.

COLLINS, LORIN C., judge, apptd. justice supreme ct., Canal Zone, June 21, 1905; died Sept. 27, 1912.

COLON, BARTOLOMÉ, brother of Christopher Columbus; born, probably in Genoa, about 1445; in 1488 visited England to interest Henry VII in the scheme of his brother, but met with no success. Returning to Spain he followed the second voyage of his brother with a fleet carrying supplies, arriving at Isabella in June 1493. The admiral made him Adelantado, and from 1496 to 1498 he governed the island during his brother's absence. Founded Santo Domingo in 1496. In 1500 Bobadilla sent him a prisoner to Spain, where he was finally released. He was with his brother on his fourth voyage, 1502–04, and was the leading spirit when active work was to be done. In 1509 he accompanied Diego Colon to Hispaniola, where he held many important and lucrative offices. Died at Santo Domingo, May, 1515.

COLON, DIEGO, son of Christopher Columbus; born probably at Lisbon, about 1476; Queen Isabella made him a page at Spanish court in 1492 where he remained until after his father's death; in 1520 he was confirmed as admiral of the Indies, and Gov. of Hispaniola, but without the title of viceroy. He arrived at Santo Domingo, July 10, 1509. Velazquez, whom he sent to conquer Cuba, threw off his authority. In 1523 he was recalled to Spain to answer charges which had been made against him, but was never brought to trial. Diego Colon apptd. Balboa gov. of Tierra Firme. He died at Montalvan, near Toledo, Feb. 23, 1526.

COLON, LUIS, Duke of Veragua and Marquis of Jamaica; born in Santo Domingo in 1521; son

of Diego Colon, and grandson of Christopher Columbus; in 1536 relinquished all claim to title of viceroy, and in return was created Duke of Veragua; in 1530 was imprisoned for having three wives, and was banished to Oran, Africa, where he died.

COLUMBUS, CHRISTOPHER (CRISTÓBAL COLON), discoverer of America; born Genoa, 1446, died Valladolid, Spain, 1506; discovered Isthmus of Panama, 1502.

COMBER, WILLIAM GEORGE, res. engr., div. dredging, dept. Operation and Maintenance, The Panama Canal; born London, Eng., Sept. 14, 1855; ed. pub. schools there; removed to U. S. 1883; asst. engr. in charge of dredging div. on Mississippi River, 1898; asst. engr., in charge of gen. survey of Mississippi River, 1902; apptd. res. engr., Cristobal div., Canal Zone, 1905; div. engr. La Boca, 1907; chmn. bd. steamboat insp. service, Canal Zone, Nov. 12, 1909–Apr. 25, 1913; married Hattie Belle Gilbert; add., Paraiso, Canal Zone.

CONCHA, JOSÉ VICENTE, diplomat; secy. of war of Columbia, Minister to U. S., 1901-02; formulated draft of treaty for transfer of French canal company's property to U. S. and cession of Panama canal zone to U. S.

CONNOR, M. E., physician, health officer of Panama, The Panama Canal; add., Ancon, Canal Zone.

COOKE, FREDERICK H., civ. engr., U. S. N., designing engr., Dept. Operation and Maintenance, The Panama Canal, since Jan. 2, 1912; born Mar. 11, 1879; commd. U. S. N., Jan. 1, 1904; add., Culebra, Cana. Zone.

COOKE, TOM M., apptd. coll. revenue, Canal Zone, 1904.

CORCORAN, A. T., apptd. gen. foreman, in chg. locomotive dept., mech. div., Canal Zone, 1910.

CORNISH, L. D., apptd. designing engr., dept. lock and dam constrn., Culebra, 1907; apptd. to Washington Off., Isthmian Canal Commn., Sept., 1905; born Lee Centre, N. Y.; grad. Syracuse Univ., with degree of C. E.

CORNTHWAITE, H. G., asst. chief hydrographer, The Panama Canal; add., Culebra, Canal Zone.

CORSE, W. B., res. engr., first dist., Pacific div., Canal Zone; died 1911.

COSA, JUAN de la, Spanish navigator; date of birth unknown; was pilot of Columbus on his first voyage of discovery; made five voyages to coast of South America, 1499, 1500, 1504, 1507, and 1509; was killed by Indians near Bay of Cartagena, Nov. 1509; his map of the world, made in 1500, is the oldest known. It is now the property of the Spanish Govt.

CRAIG, JAMES G., apptd. July 16, 1909, senior traveling engineer, The Panama Canal and P. R. R.; born Atlanta; went to Panama as loco. engr., 1905.

CROMWELL, WILLIAM NELSON, late general counsel of New Panama Canal Co., of France, and chief negotiator in transfer of Panama Canal to U. S.; born 1854; son of Col. John Nelson Cromwell; L. L. B., Columbia, 1876 (LL.D. Kenyon Coll. 1904); senior of law firm, Sullivan and Cromwell; specialty is corporation law; organized, 1899, National Tube Co. (capital $8,000,000); since then many other corporations; apptd. assignee and reorganized Decker, Howell & Co., 1890, N. P. R. R. Co., and later Price, McCormick & Co., which had failed for several millions, and many others, and put all on paying basis; was officer or counsel of more than 20 of largest corporations in U. S., and one of organizers of U. S. Steel Corpn.; for several years represented New Panama Canal Co. in negotiations at Washington, Paris, Panama and Bogotá; dir. Am. Bank Note Corpn., Mercantile Nat. Bank, N. Y.; trustee Am. Surety Co. of New York; clubs—Lawyers', Union League, Metropolitan; summer home Seabright, N. J.; res. 12 W. 49th St., New York; office 49 Wall St., New York, N. Y.

CROWLEY, D. E., resigned as supt. of constrn., Empire dist., Central div., May 11, 1910.

CUMMINGS, E. E., master mech., Gorgona shops until June 1909.

CURL, HOLTON C., Surg. U. S. N., supt. Colon hosp., 1905; add., navy yard, Mare Island, Cal.

CUSHING, CALEB, American diplomat; born Salisbury, Mass., 1800; died Newburyport, Mass., 1879; member Congress 1833–43; judge sup. court Mass., 1852; atty.-gen. U. S., 1853; counsel for U. S. in Alabama claims; nom. chief justice of U. S., 1874, but not confirmed; minister to Spain, 1874–77; went to Bogotá, 1869, and assisted in negotiation of treaty for Isthmian Canal; treaty not ratified.

D

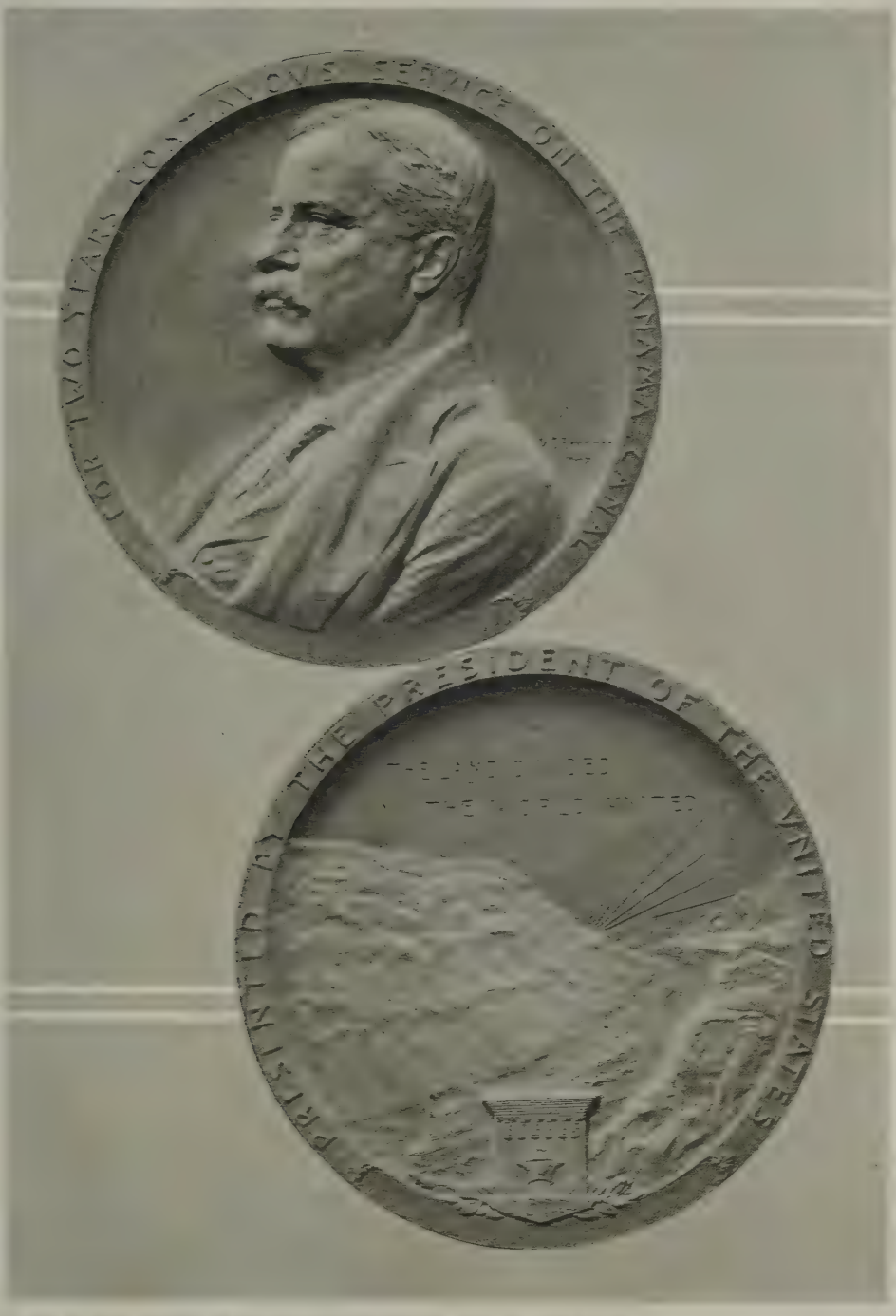
DAMPIER, WILLIAM, English freebooter; born Eng. 1652; was with Captain Sharp when that freebooter attempted to capture Panama. In 1685 he led an expedition across the Isthmus to lie in wait for the treasure fleet. It resulted in failure, and he then turned to attack Leon, Nicaragua. There he met with no better success. He circumnavigated the globe four times. Died, London, 1715.

DARLING, SAMUEL T., physician; apptd. to Isthmus Feb. 28, 1905, prof. duties included interne, physician, pathologist and ch. of laboratory; native of Harrison, N. J.; grad. Coll. Physicians and Surgeons, Balto., 1903; res. pathologist of City Hosp. in Baltimore, and instructor in Histology and Pathology, Coll. Physicians and Surgeons, Balto., 1903–5; pres. Canal Zone Medical Assn. 1907; married Miss Llewellyn of Charlottesville, Va., 1905.

DAUCHY, WALTER E., apptd. div. engr., dept. of constrn., Canal Zone, 1904.

DAVIS, CARLETON, E., engr. in charge of waterworks, sewerage, Canal Zone, 1904; apptd. ch. bu. waterworks, sewerage and roads, Canal Zone, 1905.

DAVIS, GEORGE W., major general, U. S. A., mem. Isthmian Canal Commn., 1904–5; chmn. bd. of consulting engrs. on type of Panama Canal, 1905–6; born Thompson, Conn., July 26, 1839; son of George and Elizabeth Grow Davis; married Carmen Atocha of Washington, Apr. 30, 1870; ed. Nichols Acad. Dudley, Mass., and State Normal Sch. New Britain, Conn.; served



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through Civil War; hon. mustered out Apr. 30, 1866; capt. 14th U. S. Inf. Jan. 22, 1867; maj. 11th Inf. Aug. 16, 1894; trans. to 9th Inf. May 29, 1897; lt. col. 14th Inf. Apr. 26, 1898; brig.-gen. U. S. V., May 4, 1898; hon. discharged Apr. 14, 1899; col. 23d Inf. Oct. 19, 1899; brig. gen. Feb. 2, 1901; maj. gen. July 21, 1902; gen. mgr. and v. p. Nicaragua Canal Constrn. Co., 1900–3; retired by operation of law, 1903; clubs—Metropolitan, Chevy Chase; add., The Connecticut, Washington, D. C.

DEEKS, W. E., physician; born Morrisburg, Canada; grad. McGill Univ., studied in London, Berlin and Vienna; worked in Canada and United States; went to Isthmus 1906, apptd. head of medical clinic Ancon hospital.

de LESSEPS, Count FERDINAND, builder of Suez Canal and projector of Panama Canal; born Versailles, Nov. 10, 1805; died Dec. 7, 1894; son of Mathieu and Catherine (de Grivegnée) de Lesseps; mother was a grand-aunt of Empress Eugenie; married Mlle. Agathe Delamalle, 1837; married Mlle. Autard de Bragard, 1869; ed. Coll. of Henry IV, Paris; commissary in army, 1818–20; vice consul at Lisbon, 1825–27; held positions in administration of Foreign Affairs at Tunis, Egypt, Holland and Spain; Minister to Spain 1848; while in Egypt became interested in project for a canal across Isthmus of Suez; returned to Egypt in 1854 and submitted sketch for canal to Said Pasha; the sketch was approved and active work begun 1859; canal completed under his supervision 1869; made survey for canal across Panama 1879; investigated the route through Nicaragua; decided in favor of Panama; as projected by him canal was to be a sea level connection between the two oceans; company became bankrupt after much work was done, and de Lesseps sentenced to a term of imprisonment; elected mem. Acad. of Sciences, 1875, and of Académie Française, 1884; Chevalier Legion of Honor; author of a number of books, most of them concerning the Suez and Panama Canals. His memoirs, written for his children, have been translated into English.

DERRICK, C., apptd. asst. engr., charged with the design of movable dams, Culebra, Sept. 15, 1908.

DESHON, GEORGE D., lt. col. med. corps., U. S. A., supt. Ancon hospital, The Panama Canal; born Aug. 5, 1864; grad. U. S. Mil. Acad.; 2d lt., July 1, 1886; resigned, Mar. 21, 1890; apptd. asst. surg., U. S. A., May 5, 1892; capt., asst. surg., May 5, 1897; maj. surg., Dec. 5, 1904; lt. col., Aug. 6, 1912; add., Ancon, Canal Zone.

DEVOL, CARROLL A., brig. gen. qmr. corps, U. S. A.; born in Washington Co., Ohio, April 17, 1859; ed. Pennsylvania Mil. Col. and in 1879 commissioned 2nd lt. U. S. A.; 1st lt. 1886; capt. 1896; major 1902; lt. col. 1909; col. 1911; apptd. brig. gen. qmr. corps, 1913; served with credit in Philippines; stationed in San Francisco at time of the great earthquake and at request of City Council took charge of receipt and distribution of all supplies; in June, 1908, ordered to Canal Zone to take charge of depts. of Labor and Quarters, and Material and Supplies; add. office Qmr. Gen., Washington, D. C.

DIAZ, PEDRO A., twice gov. of Panama; born City of Panama, July 5, 1854; ed. pub. schools of Panama; married Kerima Guterrez, 1879; apptd. secy. treas. 1910.

DICKINSON, JACOB McGAVOCK, born Jan. 30, 1857, at Columbus, Miss.: son of Henry and Anna (McGavock) Dickinson; ed. Nashville Univ., and at law school, Columbia Col. N. Y.; married Martha Overton, of Nashville, Tenn., Apr. 20, 1876; admitted to bar 1874; practiced at Nashville 1874–99; Chicago, 1899–09; served several terms by spl. commn. on supreme bench of Tenn.; asst. atty. gen. of U. S., 1895–7; counsel for U. S. before Alaskan Boundary Tribunal, 1903; gen. solicitor I. C. R. R. Co., 1899–01, and gen. counsel 1901–9; Secy. of War in cabinet of Pres. Taft, Mar. 4, 1909–May, 1911, in which capacity he was active in prosecuting the work of building the canal; clubs—Wayfarers, Cliff Dwellers, Industrial (Chicago), Metropolitan, University (Washington); add. Stahlman Bldg., Nashville, Tenn.

DICKSON, TRACY CAMPBELL, col. U. S. A.; born Independence, Iowa, Sept. 17, 1868; apptd. U. S. Mil. Acad. 1888; on graduating commissioned 2nd lt. artillery corps, two years later transferred to ord. dept.; 1st lt. 1894; capt. 1901; major 1906; lt. col. 1912; col. 1915; in 1910 ordered to Canal Zone, duty being to inspect shops at various points; detached Mar. 7, 1914; add. ord. dept. Sandy Hook Proving Ground, Ft. Hancock, N. J.

DISMUKES, DOUGLAS E., comdr., U. S. N.; capt. of the port, The Panama Canal; born Oct. 1, 1869; grad. U. S. Nav. Acad.; add. Cristobal, Canal Zone.

D'OLIER, WILLIAM LIVINGSTON; pres. D'Olier Eng. Co., pres. D'Olier Centrifugal Pump and Machine Co., Phila., Pa.; as construction engineer built steam power plants at Gatun and Miraflores for Isthmian Canal Com.; born Phila., Pa., Dec. 9, 1871; son of Henry and Kate B. D'Olier; ed. Phila. High School; married Harriet Coombs Harvey, Phila., Dec. 12, 1900; until 1894 engaged in cotton and cotton manufacturing business; invented and patented improvements on extractors and centrifugal machines in sugar, textile and powder industries; designed and invented sewage purification apparatus; mem. Am. Soc. Mech. Engrs.; mem. Albany Soc. C. E.; mem. Permanent International Assn. Nav. Cong.; mem. Phila. Manufacturers Club; add. Morris Bldg., Phila., Pa.

DONAHUE, JOHN V., apptd. asst. supt. of constrn., Chagres dist., Central div., May 1, 1910; born Grafton, O., went to Isthmus 1907, as foreman construc., Culebra.

DOYING, WILLIAM ALBERT EDWARD, inspecting engr. The Panama Canal since 1908; born Danville, Quebec, Can., June 13, 1867; son of Ira E. and Sarah J. Doying; married Caroline A. Huttner, N. Y. City, June 25, 1900; mem. cl. of 1900, Stevens Inst.; machinist 1889–90; elec. contracting, Summit, N. J., 1891–3; supt. erection hotel bldgs. and cottages, Summit, N. J., 1894–6; drafting dept., Western Elec. Co., 1896–7; gen. engineering work, Met. St. Ry., N. Y., 1895–

05; squad master on sub-stations and carhouses, expert in courts on construction and equipment; asst. insp. engr., Isthmian Canal Comn., New York, 1905–8; mem. committees on standardization of elec. lamp specifications, Portland cement specifications, and rubber specifications; mem. Am. Soc. Mech. Engrs., Am. Soc. Civ. Engrs., Am. Inst. Elec. Engrs., Wash. Soc. Engrs., Nat. Geo. Soc., Sons Am. Revolution; res. 3525 14th St., office The Panama Canal, Wash., D. C.

DRAKE, Sir FRANCIS, British admiral; born near Tavistock, Devonshire, England, about 1545. Early went to sea, and was a captain under Hawkins at the attack on San Juan de Ulloa, 1570, where he displayed great gallantry. He became the terror of the Spanish and captured many ships, and looted several settlements in America. In one of his expeditions he circumnavigated the globe. Died on board his ship at Nombre de Dios, Isthmus of Panama, Jan. 28, 1595.

DURAN, F. MUTIS, apptd. ch. jus. Supreme Court, Canal Zone, June 1, 1905; court dissolved 1914.

DURHAM, H. W., apptd. res. engr., bu. waterworks, sewers and roads, Canal Zone, 1904.

DUTROW, HOWARD V., physician; born Charlesville, Md.; grad. Univ. of Md. 1904 as M. D.; went to Isthmus 1905 on staff of Colon hospital; asst. physician Culebra district; physician Corozal; assistant eye and ear clinic Ancon hospital.

E

EARNSHAW, GEORGE EDWARD, pres. Earn Line Steamship Co., operating between United States ports and Panama; born Cambridge, Eng. May 29, 1846, son of Rev. Samuel and Anna (Watt) Earnshaw; ed. private tuition in Eng. and private schools in Germany; married Helen Heffelfinger, June 14, 1900, at Phila., Pa.; was an export merchant at Birmingham, Eng. from 1870 to 1884; in 1884 removed to Phila. and joined in establishing the Earn Steamship Co.; mem. Hist. Soc. of Pa., Pa. Acad. Fine Arts, Am. Acad. Political and Social Science, Art Club of Phila., Phila. Country Club, Marion Cricket Club; res. 282 South 23d St., Phila.

EASON, J. J., gen. foreman in charge, car and foundry, mech. div., dept. of Construction and Engineering, The Panama Canal since 1910.

EDWARDS, CLARENCE R., brig. gen. U. S. A., ch. Wash. Office, Isthmian Canal Comn., June 21, 1905–Nov. 15, 1905; born Jan. 1, 1859; grad. U. S. Mil. Acad., 2d lt., June 13, 1883; 1st lt., Feb. 25, 1891; capt., July 30, 1898; brig. gen. ch. bu. insular affairs, June 30, 1906; brig. gen. May 12, 1912; add., Tivoli Hotel, Ancon, Canal Zone.

EHLE, BOYD, apptd. res. engr., Canal Zone, 1904.

EINSTEIN, JAMES H., pres. and gen. mgr., Tower Manufacturing and Novelty Co., New York, N. Y., contractors for office supplies for Canal Zone; born St. Louis, Mo., 1870; ed. pub. schools St. Louis; married Augusta Liebknecht, 1904; club—Arkwright; add. 326 Broadway, New York, N. Y.

ELLIOTT, MALCOLM, prin. hydrographer, div. of meteorology and river hydraulics, 1907–10.

EMBREE, C. J., asst. engr., elec. and mech. engr., the Panama Canal, since Oct. 26, 1913; add. Culebra, Canal Zone.

ENCISO, MARTIN FERNANDEZ de, Spanish lawyer; born 1470; went to America with Bastidas in 1500, practiced law in Santo Domingo, and joined Ojeda in colonizing Tierra Firme in 1509; founded Antigua, but was deposed by Balboa; went to Spain, returning with Pedrarias, and led expedition against Indians of Cenú; wrote first book in Spanish on the New World; died 1528.

ENDICOTT, MORDECAI T., rear adml., U. S. N., mem. Isthmian Canal Comn., Apr. 1, 1905–March 15, 1907; born May's Landing, N. J., Nov. 26, 1844; son of Thomas D. and Ann (Pennington) Endicott; ed. prep. parochial school; C. E., Rensselaer Poly. Inst., 1868; married Elizabeth Adams, May 29, 1872; apptd. civ. engr., U. S. N., 1874; apptd. mem. Nicaragua Canal Comn., 1895; apptd. ch. bu. yards and docks, navy dept., 1898 with rank of commodore; later advanced to rank of rear adml.; retired 1906 but continued on active duties until 1909; mem. Am. Soc. C. E. (pres. 1911); clubs—Army and Navy, Cosmos, (Washington); Engineers' (New York); add. 1330 R St., Wash., D. C.

ERNST, OSWALD H., brig. gen., U. S. A., mem. Isthmian Canal Comn., Apr. 1, 1905–June 30, 1906; born nr. Cincinnati, O., June 27, 1842; son of Andrew Henry and Sarah H. Ernst; attended Harvard 1858–60; grad. U. S. Mil. Acad. 1864; married Elizabeth Amory, of Roxbury, Mass., Nov. 3, 1866; 1st lt. engrs., 1864; capt. Mar. 1867; maj., May 5, 1882; lt. col., Mar. 31, 1895; brig. gen. vols., May 27, 1898–June 12, 1899; col. Feb. 20, 1903; brig. gen. June 27, 1906; mem. Isthmian Canal Comn., 1899–1901 and 1905–6; pres. Miss. River Comn., 1903–6; dir. Panama Railroad since 1905; retired June 27, 1906; mem. Loyal Legion, Mil. Order Foreign Wars, Am. Soc. C. E.; clubs—Metropolitan Chevy Chase; author Manual of Practical Military Engineering, etc.; add. 1321 Conn. Av., Washington, D. C.

ESPINOSA, MANUEL B., leader in movement for independence of Panama; native of Cartagena; ed. priv. schools Cartagena; moved to Panama in 1873 and began business for himself in 1881; important figure in commercial world since that time; owns largest drug business on the Isthmus, and has large real estate holdings; assisted greatly in development of Panama; married in 1884 to Elisa Remon; add. Ancon, Canal Zone.

F

FAIRBANKS, CHARLES WARREN, ex-V. P. of U. S.; born on farm nr. Unionville Center, O., May 11, 1852; son of Loriston M. and Mary A. (Smith) Fairbanks; A. B., Ohio Wesleyan Univ., 1872; A. M., 1875; (LL.D. 1901; LL.D. Baker Univ., 1903, Ia. State Univ., 1903, Northwestern, 1907); was agent for the Associated Press at Pittsburgh and Cleveland,

1872–4; admitted to Ohio bar 1874 and established practice at Indianapolis; married Cornelia Cole, of Marysville, O., 1874 (she died Oct. 24, 1913); chmn. rep. state convs. 1892, 1898; del. at large rep. nat. convs. St. Louis, 1896 (temporary chmn.), Phila. 1900 (chmn. com. on resolutions), Chicago, 1904 (unanimously nominated for v. p.), Chicago, 1912 (chmn. com. on resolutions); Rep. caucus for U. S. senator, 1893, but defeated by David Turpie, dem.; elected U. S. senator from Ind., for terms 1897–03, 1903–09; resigned Mar. 4, 1905; elected V. P. of U. S. on ticket with Theodore Roosevelt, Nov. 1904, term expiring Mar. 4, 1909; was U. S. senator when Congress had before it question of constructing the Panama Canal; so that work might not stop at any time for want of funds, offered amendment to Spooner bill providing for issue and sale of bonds when money needed for construction work; res. Indianapolis, Ind.

FAUCETT, N. S., apptd. dep. treas., Wash. Off., Isthmian Canal Comn., 1904.

FAURE, Ad., cost keeping accountant, in office of chmn. and chief engr., The Panama Canal; add. Culebra, Canal Zone, since 1910.

FEUILLE, FRANK, spec. atty., The Panama Canal; born Havana, Cuba, Sept. 10, 1860; apptd. law clk., dept. justice in Porto Rico; later asst. atty. gen.; apptd. spec. judge, 1904; apptd. atty. gen. of Porto Rico, 1905; apptd. by exec. order, April 16, 1910, counsel and ch. atty. for Isthmian Canal Comn. and Panama R. R.; add. Ancon, Canal Zone.

FIELDS, J. B., gen. foreman in charge erection of buildings, The Panama Canal, since Dec. 5, 1913; add. Culebra, Canal Zone.

FILOS, FRANCISCO, secy. of state and justice, Republic of Panama; ed. at Cartagena; served as atty. gen.; was mem. law firm with Pres. Porras.

FINLEY, GEORGE I., asst. engr., charge of design of structural work on permanent shop buildings, dept. of construction and engineering, The Panama Canal.

FLINT, A. L., asst. chief of office, The Panama Canal; add. Washington, D. C.

FLYNN, J. H., apptd. ch. draftsman, Canal Zone, 1909; grad. Mass. Inst. Tech.; went to Isthmus 1905; ch. draftsman mechanical div., 1906; mechanical engr., I. C. C., since 1909.

FORBES, S. G., elect. supt. Atlantic div.; b. Ala.; grad. Ala. Polytech. Inst. degree B. S. 1900; went to Isthmus 1907 as foreman elect. dept.; apptd. station engr. Gatun in chg. power plant for locks and dams; apptd. elect. supt. Atlantic div.

FREEMAN, F. C., supt. div. of clubhouses, dept. of engr. and construction since 1907; secy. International Comn. Young Men's Christian Association of North America, The Panama Canal; born Randolph, N. Y.; ed. Univ. of Mo., Univ. of Colo.; married Bernice G. Hackenberg 1909.

FRENCH, H. F., apptd. prin. hydrographer, 3d div., ch. engr's. off., Culebra, Jan. 1, 1910.

FYFFE, JAMES PERRY, police chief; born Maysville, Ky.; grad. Ky. State Univ. and Cincinnati Univ.; practiced law; apptd. ch. div. of police and prisons Canal Zone 1910.

G

GAILLARD, DAVID DuBOSE, lt. col. Corps. of Engrs., U. S. A., mem. Isthmian Canal Comn. and dir. Panama R. R. Co., Mar. 16, 1907–Dec. 5, 1913; born Fulton P. O., S. C., Sept. 4, 1859; son of Samuel Isaac and Susan Richardson DuBose Gaillard; married at Winnsboro, S. C., Katherine Rose Davis, of Columbia, S. C., Oct. 6, 1887; ed. pvt. country sch., Clarendon Co., S. C., and Mt. Zion Sch., Winnsboro, S. C., 1872–4; apptd. from S. C. and grad. U. S. Mil. Acad., 1884; Eng. Sch. of Application, 1887; apptd. 2d lt. engrs., June 15, 1884; 1st lt., Oct. 27, 1887; capt., Oct. 25, 1895; col. 3rd U. S. V. engrs., June 7, 1898; hon. mustered out, May 17, 1899; maj. Apr. 23, 1904; lt. col. Apr. 11, 1909; asst. to Capt. W. M. Black, and in charge various surveys and harbor improvements at St. Augustine and Tampa and Withlacoochee River, Fla., 1887–91; mem. Internat. Boundary Comn., U. S. and Mex., 1891–4; in chg. Washington Aqueduct 1895–8; on staff Maj. Gen. J. F. Wade, U. S. V., Apr.–June, 1898; served in U. S. and Cuba, June 1898–May 1899; ch. engr. dept. of Santa Clara, Cuba, Feb.–Apr., 1899; asst. to engr. commr. of D. C., 1899–1901; in chg. of all river and harbor improvement of Lake Superior, 1901–3; mem. gen. staff corps and engr. officer Northern Div. 1903–4; on duty at Army War College, 1904–6; chief mil. information div., army of Cuban pacification at Marianao, Cuba, Oct. 1906–Feb. 1907; supervising engr. in charge of dredging in harbors, building breakwaters, etc., Apr. 1, 1907–July 1, 1908; div. engr. Central Div., Gatun to Pedro Miguel, from July 1, 1908; author of "Wave Action in Relation to Engineering Structures," 1904; died Baltimore, Md., Dec. 5, 1913.

GARELLA, NAPOLEON, French engr.; in 1843 surveyed Panama Canal route, recommended a tunnel through Culebra.

GARLINGTON, CRESWELL, 1st. lt. Corps of Engrs., U. S. A., in charge fortification work, The Panama Canal; born June 23, 1887; grad. U. S. Mil. Acad.; apptd. 2d lt. engr., June 15, 1910; 1st lt. Feb. 27, 1913; add. Culebra, Canal Zone.

GARRISON, LINDLEY MILLER, born Camden, N. J., Nov. 28, 1864; son of Joseph Fithian and Elizabeth (van Arsdale) Garrison; educ. pub. schools, Episcopal Acad., Phila., and Univ. of Pa.; married, Jan. 30, 1900, Margaret Holden, at Jersey City, N. J.; B. L. Univ. of Pa.; practiced law until Jan. 15, 1904, to become Vice Chancellor of N. J.; took oath of office as Secretary of War in Cabinet of Pres. Wilson, March 5, 1913; clubs—Lotus (N. Y.); Harvard (N. J.); Army and Navy, and Univ. (Wash. D. C.); res. 1830 Connecticut Av., Wash. D. C.

GAUSE, FRANK A., supt. schools Canal Zone, Aug. 23, 1909–Aug. 23, 1913; born Westfield, Ind., Mar. 1, 1874; son of Amos W. and Margaret (Morrow) Gause; grad. Friends' Acad., Westfield, Ind., 1891; A. B. Ind. Univ. 1904; M. A. 1905; married Rose Carey, 1896; dist. sch. teacher 1892–4; asst. prin. Friends' Acad., 1894–5; supt. schools Cicero, Ind., 1897–1903;

author, Story of Panama; An Isthmian Idyl; res. Westfield, Ind.

GERIG, WILLIAM, div. engr., Gatun dam div., 1907; div. engr., Colon dredging div., 1907.

GIBSON, COLLINS P., apptd. asst. supt. of Empire dist., Central div., Canal Zone, May 11, 1910.

GILMORE, MAURICE E., born Somerset, Ky., Sept. 14, 1880; son of Cyrus B. and Elizabeth Gilmore; ed. Kendall Col. and Univ. of Mo. (B. S. and C. E.); served Span.-Am. War under Col. Roosevelt; apptd. levelman Isthmus Panama in 1908, worked for Panama R. R. in various positions from levelman to asst. engr.; asst. engr. in charge of surveys on 110 miles of railroad between Chame and Santiago for Panama Gov.; served two years as supt. pub. wks. for Isthmian Canal Comn. in Panama, Colon and Canal Zone; clubs—Univ. Strangers, and Tivoli, and the Chanticleer and Chagres Soc.; add. Ancon, Canal Zone.

GOETHALS, GEORGE WASHINGTON, major gen. U. S. A., governor of The Panama Canal; apptd. chairman and ch. engr. Isthmian Canal Comn. Feb. 26, 1907; completed the Panama Canal; by executive order and in conformity with Panama Canal Act of Aug. 24, 1912, organization of Isthmian Canal Comn. was abolished and The Panama Canal contemplated by the act was made effective; Col. Goethals was then apptd. governor of the Panama Canal; born Brooklyn, June 29, 1858; student Col. of City of N. Y., 1873–6; grad. U. S. Mil. Acad. 1880; 2d lt. engrs. June 12, 1880; 1st lt. June 15, 1882; capt. Dec. 14, 1891; lt. col., ch. engr. vols. May 9, 1898; hon. discharged from vol. service Dec. 31, 1898; maj. Eng. Corps Feb. 7, 1900; grad. Army War Col. 1905; lt. col. Mar. 2, 1907; col. Dec. 3, 1909; maj. gen., Mar. 4, 1915; instructor in civil and mil. engineering, West Point, several years until 1888; in charge canal construction, Mussel shoals; ch. of engrs. during Spanish-American War; mem. board of fortifications (coast and harbor defense); LL.D., Yale, Harvard; mem. Delta Upsilon; add. Balboa Heights, Canal Zone, Panama.

GOETHALS, GEORGE R., son of Geo. W. Goethals; capt. Corps of Engrs., U. S. A., in charge construction of gun and mortar batteries for defense of the canal since Jan. 1, 1912; born March 4, 1886; grad. U. S. Mil. Acad., 2d lt. engr. Feb. 14, 1908; 1st lt. Feb. 27, 1911, capt. 1915.

GOLDMARK, HENRY, designer of steel lock gates used at Panama Canal; born N. Y. City, June 15, 1857; grad. Polytechnic Inst. (Brooklyn); Harvard Univ. and Royal Polytechnic Univ. of Hanover; before entering upon a contract with the Canal Comn. had been connected with many notable engineering projects of U. S. and Canada; des. engr., in chg. structural designing, Washington Off., Isthmian Canal Comn., 1907–1908, then transferred to Isthmus as designing engr. locks, gates and protective devices, at Culebra.

GONZALEZ, GIL, Spanish explorer; born at Ávila about 1470. Was one of the most intrepid of the Spanish explorers who followed the footsteps of Columbus. In 1511 he was made Contador of Hispaniola. In June, 1519, the Gov. of Castilla del Oro was directed by the Spanish government to turn over to Gonzalez the vessels that had been built for Vasco Nuñez, and with these he was to explore the South Sea. In this expedition he was very successful. He coasted along the South Sea, and dividing his command he made an expedition into the interior, where in 1522 he discovered Lake Nicaragua. He was in a continual quarrel with Pedrarias, but on his return to Panama in 1523 he boasted he had coasted 650 leagues, traveled by land 324 leagues, and converted 32,000 souls. He brought back with him 112,000 pesos of gold. Died at Ávila about 1528.

GOOLSBY, E. M., clerk of the courts, The Panama Canal, since Apr. 1, 1914; add. Ancon, Canal Zone.

GORGAS, WILLIAM CRAWFORD, maj. gen. surg. gen. U. S. A.; chief sanitary officer, Panama Canal Mar. 1, 1904, and mem. Isthmian Canal Comn., 1907–Mar. 31, 1914; born Mobile, Ala., Oct. 3, 1854; son of Gen. Josiah (C. S. A.) and Amelia Gayle Gorgas; married Marie Cook Doughty of Cincinnati, Sept. 15, 1885; A. N., Univ. of the South, 1875; M. D., Bellevue Hos. Med. Col. (New York Univ.), 1879; Interne Bellevue Hosp., 1878–80; (hon. Sc. D., Univ. of Pa., 1903, Univ. of the South, 1904, Harvard, 1908, Brown, 1909, Jefferson Med. Col., 1909; LL.D., Univ. of Ala., 1910, Tulane, 1911); apptd. surg. U. S. A., June 16, 1880; capt. asst. surgeon June 16, 1885; maj. brigade surgeon vols., June 4–July 6, 1898; maj. surgeon, July 6, 1898; chief sanitary officer of Havana and in charge of sanitary work there, 1898–1902, applied methods of combatting yellow fever which eliminated that disease in Havana; col., asst. surgeon-gen., by spcl. act of Congress, for yellow fever work at Havana, Mar. 9, 1903; mem. Isthmian Canal Comn. Mar. 4, 1907; recipient of Mary Kingsley medal from Liverpool Sch. of Tropical Medicine, May 27, 1907; hon. fellow N. Y. Acad. Medicine, 1908; assoc. fellow Col. of Physicians of Phila.; asso. mem. Société de Pathologie Otolique, Paris, 1908; pres. A. M. A., 1908–9, Am. Soc. Tropical Medicine, 1910; mem. Am. Pub. Health Assn., Assn. Mil. Surgeons (v. p.); U. S. del. 1st Pan-American Med. Congress, Santiago, Chili, 1908; apptd. surg. gen. with rank of brig. gen., Jan. 16, 1914; maj. gen., Mar. 4, 1915; add. War Dept., Wash., D. C.

GREENSLADE, GEORGE A., gen. supt., 4th div., ch. engrs. off., The Panama Canal, since May 1, 1910.

GROVE, WILLIAM R., maj. qmr. corps, U. S. A., inspr. Supply Dept., The Panama Canal since Apr. 1, 1914; comd. capt. U. S. A., Feb. 2, 1901; maj. Dec. 10, 1911; add. Cristobal, Canal Zone.

GRUNSKY, CARL EWALD, civil engr., mem. Isthmian Canal Comn., 1904–5; born San Joaquin Co., Cal., Apr. 4, 1855; son of Carl Albert Leopold and Clotide Josephine Frederica (Camerer) Grunsky; grad. Stockton (Cal.) High Sch., 1870, Realschule, Stuttgart, Germany, 1872–4; Polytechnikum, Stuttgart, 1874–7, grad. at head of class; married Mattie Kate Powers, of Sacramento, Cal., Mar. 12, 1884; asst. and ch. asst. engr. of Cal., 1879–80; mem. San Fran. Sewerage Comn., 1892–3; city engr., San Fran.

1900–4; consulting engr. U. S. Reclamation Ser., 1905–7; consulting engr. at New York since 1907; mem. Am. Soc. C. E., Tech. Soc. of the Pacific Coast, Cal. Acad. of Sciences; add. 45 Broadway, New York.

GRUVER, Dr. F., apptd. quarantine officer, Panama, 1907.

GUARDIA, AURELIO, secy. Finance, Panama; born San Carlos, prov. Panama; ed. pub. schools; apptd. Minister of Hacienda of prov. Cocle, 1888; rep. prov. Cocle in Nat. Cong. of Colombia, 1892–4; also prefect and fiscal in Cocle, and circuit judge in Colon; married in 1880; since 1904, superior judge.

GUDGER, HEZEKIAH ALEXANDER, chief justice Supreme Court Canal Zone since Jan. 4, 1909; born Marshall, N. C., May 27, 1850; son of Joseph J. and Sarah E. (Barnard) Gudger; ed. Leicester Acad. and Weaverville Col., N. C., to 1870 (A. M.); grad. Bailey's Law Sch., Asheville, N. C., Aug. 10, 1875; practiced law Asheville; elec. to N. C. legis. 1872, 1874; prin. N. C. Instn. for Edn. of the Deaf, Dumb and Blind, 1877–83; resigned to reënter practice law, Jan. 1883; elec. to N. C. Senate 1885; Am. Con. Gen. to Panama, 1897–1905; justice Supreme Court Canal Zone, Feb. 24, 1905; Grand Master Masons of N. C., two terms; add. Ancon, Canal Zone, Panama.

GUTHRIE, M. C., physician, chief quarantine off., The Panama Canal; add. Ancon, Canal Zone.

H

HAGAN, JAMES MONROE, supt. constr., Empire dist., Canal Zone, since May 11, 1910; native of Greenville, Ill.; ed. pub. school; apptd. gen. foreman, Dec. 1907; asst. supt., 1908; add. Empire, Canal Zone.

HAINES, A. L., physician, b. N. Y.; grad. State Normal Col. 1880, degree M. D.; practiced med.; went to Isthmus 1905 as dist. phys. Culebra dist.; apptd. dist. phys. Empire dist. 1907.

HAINS, PETER C., brig. gen., mem. Isthmian Canal Comn., Apr. 1, 1905–March 15, 1907; born Phila., July 6, 1840; son of Reuben P. and Amanda M. Hains; grad. U. S. Mil. Acad. 1861; married Virginia P. Jenkins, Nov. 1864; 2d and 1st lt. arty. 1861; to engr. corps. 1863; capt. 1863; maj. 1870; lt. col. 1886; col. 1895; brig. gen. vols. 1898; brig. gen. 1903; mem. Nicaragua Canal Comn. 1897–9; mem. Isthmian Canal Comn., 1899–1903; retired from active service July 6, 1904; add. Washington, D. C.

HAMMER, J., mem. staff, Washington office, Isthmian Canal until Oct. 1908, then transferred to Isthmus as designing engr., lock gates and protective devices, Culebra.

HAMMOND, JOHN HAYS, engr.; born San Francisco, Mar. 31, 1855; son of Richard Pindle and Sarah Elizabeth Hays Hammond; married Natalie Harris, of Miss., Jan. 1, 1880; ed. pub. and pvt. schools; Ph. B., Sheffield Scientific Sch. (Yale), 1876, A. M., Yale, 1898; mining course at Royal Sch. of Mines, Freiburg, Saxony; (D. E., Stevens Inst. Tech. 1906); LL.D., St. Johns Col., 1907; specl. expert U. S. Geol. Survey, 1880, examining Cal. gold fields; later in Mexico and afterward consulting engr. Union Iron Works, San Francisco, and to Central and Southern Pacific Rwys.; has examined properties in all parts of the world; became consulting engr. for Barnato Bros., 1893, and later for Cecil Rhodes; pres. Am. Inst. Mining Engrs., 1907–8; clubs—Century, University (New York) and University Clubs of San Francisco, Denver, and Salt Lake City; add. 71 Broadway, New York.

HANNA, MARCUS A., champion of Panama in Panama vs. Nicaragua route; U. S. senator; born Lisbon, Ohio, Sept. 24, 1837; son of Leonard and Samantha Hanna; ed. pub. schools of Cleveland; assumed control of firm of Hanna, Garretson & Co., upon death of his father; firm dissolved in 1867 and he associated himself with Rhodes & Co., successors to Rhodes, Card & Co., pioneer coal and iron firm of Cleveland; in 1872 organized and equipped the Cleveland Trans. Co., one of the largest lines operating on the Great Lakes; pres. Union Nat. Bank of Cleveland, 1884; del. at large from Ohio to Rep. Nat. convs., 1884 and 1896; chmn. Nat. Committe, campaign Pres. McKinley; apptd. U. S. senator March 2, 1897, and reëlected 1898; died Washington, D. C., Jan. 15, 1904.

HARDING, CHESTER, col. Corps of Engrs., U. S. A., charge Atlantic Div. construction work Panama Canal; born Enterprise, Miss., Dec. 31, 1866; grad. Ala. Univ., degree B. E.; grad. U. S. Mil. Acad.; add. 2d lt. engr. June 12, 1889; 2d lt. Aug. 12, 1890; 1st lt. Jan. 26, 1895; capt. July 5, 1898; maj. June 27, 1906; lt. col. Feb. 27, 1913; col. 1915; add. Balboa, Canal Zone.

HARMON, DANIEL W., capt. med. corps, U. S. A.; health officer of Colon, The Panama Canal; born Aug. 1, 1880; 1st lt. med. res. corps July 7, 1908; grad. Army Med. School 1909; 1st lt. med. corps May 27, 1909; capt. June 25, 1912; M. D. Univ. of Va., 1903; add. Cristobal, Canal Zone.

HARPER, A. C., res. engr., surveys and borings, La Boca locks div., apptd. 1907.

HARRIS, WILLIAM B., pres. William B. Harris Co., New York, N. Y., shippers of supplies to Canal Zone; born Brooklyn, N. Y., Oct. 19, 1871; son of Samuel L. and Alice (Wilde) Harris; ed. grammar sch., Gt. Barrington, Mass.; grad. high sch. East Orange, N. J.; grad. Newark Acad.; married Callie W. Underhill, Dec. 2, 1896; add. 65 Front St., New York.

HARROD, BENJAMIN MORGAN, civil engr., mem. Isthmian Canal Comn., 1904–7; born, New Orleans, Feb. 19, 1837; son of Charles and Mary (Morgan) Harrod; A. B., Harvard, 1856, A. M., 1859 (LL.D., Tulane, 1906); married Eugenia Uhlhorn, of New Orleans, Sept. 11, 1883; pvt., lt. of arty., brigade and div. engr. and capt. engr. corps, C. S. A., in Civil War; chief state engr. of La., 1877–80; mem. U. S. Miss. River Comn., 1879–1904; city engr. of New Orleans, 1888–92; chief engr. in charge of constructing drainage system, New Orleans, 1895–1902; died Sept. 7, 1912.

HARTIGAN, FRED L., resigned as supt. of constrn., June 13, 1908.

HAUPT, LEWIS MUHLENBERG, canal com-

missioner; born Gettysburg, Pa., Mar. 21, 1844; ed. Lawrence Sc. School; grad. U. S. Mil. Acad., 1867; married Isabella Cromwell, June 26, 1873; second lt. engrs. U. S. A., 1867; resigned Sept. 20, 1869; prof. civ. engineering, univ. of Pa., 1872-92; mem. Nicaragua Canal Comn., 1897-99; mem. Isthmian Canal Comn., 1899-1902.

HAWKINS, Sir JOHN, English admiral; born at Plymouth, 1532; during 1562–7 engaged in carrying cargoes of slaves from Africa to the West Indies and the Spanish Main. This was in violation of Spanish laws, and it brought him into a conflict, Sept. 24, 1568, with a Spanish fleet in harbor of Vera Cruz. Hawkins was worsted in the fight, and escaped with difficulty, losing most of his vessels. In 1573 apptd. treasurer of the English navy. As rear admi. he took a prominent part in the defeat and overthrow of the Spanish Armada, in August 1588. Died at sea off Porto Rico, Nov. 12, 1595, while second in command of Drake's expedition.

HAY, JOHN, secretary of state, signer of Hay-Pauncefote and Hay-Bunau-Varilla treaties; born Salem, Ind., Oct. 8, 1838; son of Charles and Helen Leonard Hay; married Clara L. Stone, 1874; grad. Brown Univer., 1858; asst. secy. to Pres. Lincoln and later acted as his adjutant and aid-de-camp; soon after death of Pres. Lincoln apptd. secy. of legation Paris; 1867–8 secy. legation and chargé d'affaires Vienna; 1869 secy. legation Spain; 1st asst. secy. State 1879–81; ambassador to Great Britain, 1897; his services at the Court of St. James were of the greatest importance in promoting the spirit of amity between the two countries, and attitude of friendly neutrality which Great Britain assumed at outbreak of Spanish-Am. War may be ascribed largely to his diplomacy; apptd. secretary of state Sept. 30, 1898, and served until his death in 1905.

HEBARD, R. W., res. engr., Chagres div., Aug. 2, 1907–Oct. 2, 1909.

HECKER, FRANK JOSEPH, mem. Isthmian Canal Comn., Mar.–Dec., 1904; born at Freedom, Mich., July 6, 1846; son of Frank and Cynthia (Shield) Hecker; ed. in pub. schools; pvt., and 1st sergt. Mo. Inf., 1864–5; married Anna M. Williamson, of Omaha, Dec. 8, 1868; organized Peninsular Car Co., 1879; dir. Peoples' State Bank, Union Trust Co., Detroit Copper and Brass Rolling Mills, Detroit Lumber Co.; police commr., Detroit, 1880–90; col. q. m. vols. 1898–9; chief of div. of transportation of the army during Spanish-Am. War; clubs—Detroit, Yondotega, Country, Old, Detroit Boat; add. Union Trust Bldg., Detroit.

HELLER, CHARLES W., pres. Heller & Brightly, Phila.; furnished instruments in eng. work on Panama Canal; born Phila., May 11, 1883; son of Charles S. and Ada M. Heller; ed. North East Manual Training High School, Phila.; married Bertha A. Hurgust, Nov. 23, 1909.

HELMER, J. H., claim officer, accounting dept., The Panama Canal; add. Empire, Canal Zone.

HEPBURN, WILLIAM PETERS, ex-congressman and author of House bill providing for construction of Nicaragua Canal; born Wellsville, Ohio, Nov. 4, 1833; ed. pub. schools Iowa; (LL.D., Cornell Col., Ia., 1904); admitted to bar, 1854; dist. atty. 11th Jud. dist., 1853-61; capt., maj., and lt. col. 2d Ia. cav. 1861–65; pres. elector 1876; at large, 1888; mem. 47th–49th Congresses; Solic. Treas. 1888–93; mem. 53d–60th Congresses; chmn. Com. Interstate and Foreign Commerce, 59th–60th Congresses; add. Clarinda, Ia.

HERRICK, ALFRED B., surgeon; born Amsterdam, N. Y., ed. Williams Col. and Johns Hopkins Univ.; served 4 years in hospital work Wash. D. C. Went to Isthmus July 1904, engaging in sanitary work; apptd. chief surgical clinic Ancon hospital.

HINMAN, H. D., asst. engr., construction Pacific terminals, The Panama Canal, since Aug. 1, 1912.

HISE, ELIJAH, American diplomat; chargé d'affaires to Central America, 1848, instructed "to obtain information as to nature and extent of late British encroachments in Central America"; without authority negotiated and signed treaty with Nicaragua whereby United States undertook to defend and protect sovereignty of Nicaragua and latter country granted to U. S. exclusive canal rights; treaty never submitted to Senate.

HITT, SAMUEL M., architect permanent building div., supply dept., since Dec. 5, 1913; add. Balboa, Canal Zone.

HODGES, HARRY FOOTE, brig. gen. corps. engrs. U. S. A., engr. of maintenance, The Panama Canal; connected with the canal organization from Sept. 15, 1908, as mem. and asst. chief engr.; born Boston, Feb. 25, 1860, son of Edward Fuller and Anne Frances (Hammatt) Hodges; married Alma L'Hommedieu Raynolds, Chicago, Dec. 8, 1887; student Boston Latin Sch. and Adams Acad.; grad. U. S. Mil. Acad., 1881; 2d lt. corps. engrs., July 17, 1881; 1st lt., Feb. 20, 1883; capt., May 18, 1893; maj., May 2, 1901; lt. col., Aug. 27, 1907; col., July 11, 1911; brig. gen., Mar. 4, 1915; lt. col. 1st U. S. vol. engrs., June 10, 1898; col., Jan. 21, 1899; hon. mustered out, Jan. 25, 1899; with bat. engrs. river and harbor work, 1881–8; instr. and asst. prof. engrng. West Point, 1888–92; river, harbor and fortification work, 1892–8; in field in Porto Rico, 1898–9; river and harbor work, 1899–1901; ch. engr. dept. of Cuba, 1901–2; in office Chief Engrs. U. S. A., 1902–7; gen. pur. officer Isthmian Canal Comn., 1907–8; dir. and 2d v. p. Panama R. R. Co.; comdg. North Atlantic coast artillery dist.; mem. Army and Navy and Chevy Chase clubs, Wash. D. C.; add. Ft. Totten, N. Y.

HOFFMAN, GEORGE M., lt. col. corps of engrs. U. S. A.; res. engr. in charge of construction spillways Panama Canal, 1908–Sept. 26, 1913; born June 15, 1870; cadet U. S. Mil. Acad., June 17, 1892; apptd. add. 2d lt., June 12, 1896; 2d lt., May 18, 1898; 1st lt., July 5, 1898; capt. Apr. 23, 1904; maj., Dec. 3, 1909; lt. col., Mar. 4, 1915; add. Federal Bldg., Rock Island, Ill.

HOHLFELD, HERMAN L., pres. Hohlfeld Mfg. Co., Phila., furnished supplies to Canal Zone; born Saxony, Germany, Jan. 12, 1866; son of Henry and Caroline Hohlfeld; attended pub. sch. Adams, Mass.; married Phoebe Hobson, Phila., Jan. 1893; mem. Manufacturers Club, Trades League,

Merchants and Manufacturers Assn., Am. Civ. Alliance (Phila.).

HOLMES, FRANK, res. engr., supply dept., The Panama Canal, since Aug. 1, 1913; add. Culebra, Canal Zone.

HUFF, FRED LEON, asst. supt. of constrn., Central Div., Aug. 18, 1908–Aug. 6, 1912; born 1879, Whiteside, Mo.; went to Isthmus 1905, as gen. foreman.

HUGHES, CHARLES R., engr; grad. Cornell Univ.; went to Isthmus 1905; engaged surveys for Gatun Lake; foreman spillway excavation, 1908; supervisor spillway construction, 1910; supt. of construction of Gatun dam and spillway.

HUMPHREYS, ANDREW ATKINSON, brig. gen. U. S. A.; was mem. Interoceanic Canal Comn.; born Phila., Pa., Nov. 2, 1810; grad. U. S. Mil. Acad., 1831; resigned from service 1836 to engage in civil engineering; employed by gov. construction light-houses; 1838 apptd. lt. corps of Topographical Engrs.; 1848, capt.; for 12 years had charge of surveys for improvement of Mississippi River; 1854 surveyed railroad route from Mississippi River to Pacific coast; 1862 apptd. brig. gen. U. S. V.; 1863 apptd. chief of staff by Gen. Meade; 1864 assigned to command 2d Corps. Army of the Potomac; 1866 apptd. brig. gen., Corps of Engrs.; retired in 1879; with Admiral Ammen apptd. Commr. to make surveys for a ship canal through the Isthmus of Panama, and also through Nicaragua; died Washington, D. C., Dec. 27, 1883.

J

JACKSON, WILLIAM H., district judge, The Panama Canal, since April 1, 1914; add. Ancon, Canal Zone.

JACKSON, WILLIAM KENNETH, Jr., dist. atty., The Panama Canal since Apr. 1, 1914; pros. atty. Canal Zone since Apr. 1910: born Box Station (now Denver) Tenn., Nov. 13, 1886; son of William K. and Medora E. (Montgomery) Jackson; ed. Univ. of Fla. and Univ. of Va.; A. B. Univ. of Fla., 1904; L.L.B. Univ. of Va., 1908; practiced law in Jacksonville, Fla., as member of firm of Jackson & Nixon, 1908–9; apptd. asst. pros. atty. Canal Zone, and asst. atty. Isthmian Canal Comn., and Panama Railroad, Mar. 1909; add. Ancon, Canal Zone.

JACKSON, WILLIAM P., ex-U. S. senator; born Salisbury, Md., Jan. 11, 1868; son of William H. and Arabella (Humphreys) Jackson; ed. Wilmington Conf. Acad., Dover, Del.; married Sallie McCoombs, of Md., 1890 (died 1899), 2d Katherine Shelmerdine, of Phila., 1900; entered lumber mfg. business 1887 and assisted in organizing Jackson Bros. Co.; apptd. U. S. senator, Nov. 29, 1912, to fill vacancy caused by death of Isidor Rayner; add. Salisbury, Md.

JACOBSON, BENJ. L., dept. commissary supply dept., The Panama Canal; add. Cristobal, Canal Zone.

JADWIN, EDGAR, lt. col. Corps of Engrs., U. S. A.; served as res. eng Atlantic Div., Panama Canal; born Nov. 14, 1869; grad. U. S. Mil. Acad.; add. 2d lt., June 11, 1892; 2d lt., May 10, 1895; 1st lt., July 31, 1897; capt., May 2, 1901; maj., Feb. 28, 1908; lt. col., 1915; served through Spanish-Am. War as maj. and lt. col. 3d reg. U. S. V. Engrs.; July 18, 1907, detailed to Canal Zone as div. eng., Chagres Div.; 1908 apptd. res. eng. Atlantic Div.; in charge breakwater construction at Colon, the excavation of sea level canal from Atlantic to Gatun, and of the dry dock and machine shops at Cristobal; add. Off. Chief Engrs., Wash., D. C.

JERVEY, JAMES POSTELL, lt. col., Corps of Engrs., U. S. A., res. engr. and supt. construction locks at Panama Canal, until Sept. 26, 1913; born Nov. 14, 1869; grad. U. S. Mil. Acad.; add. 2d lt., June 11, 1892; 2d lt., May 10, 1895; 1st lt., July 31, 1897; capt., May 2, 1901; maj., Feb. 28, 1908; lt. col., 1915; detailed to duty on Isthmus July 1908; add. Custom House, Norfolk, Va.

JEWEL, LINDSEY LOUIN, engr.; born Montgomery Co., Va., 1877; grad. Va. Polytech. Inst.; went to Isthmus 1910 in charge construction of lock gates for McClintic-Marshall Construction Co., of Pittsburgh.

JOHNSON, BEN., engr.; born Greenville, Miss.; grad. West Point, 1889; resigned; went to Isthmus, 1907 as asst. supt. Gorgona; supt. of locks, 1909.

JOHNSON, LUCIUS E., pres. Norfolk and Western Ry. Co.; born Aurora, Ill., Apr. 13, 1846; son of J. Spencer and Eliza (Brown) Johnson; ed. public sch., Aurora; married Ella Parker, Apr. 10, 1869; first connection with railroad work was in capacity of locomotive fireman on C. B. R. R., in 1866; after filling various positions promoted in 1886 to div. supt.; in 1890 apptd. supt. Mont. Cent. Ry.; resigned 1889 and apptd. div. supt. L. S. & M. S. Ry.; 1897 apptd. gen. supt. N. & W. Ry.; filled positions of v. p. and gen. mgr., gen. mgr., pres. and gen. mgr.; elec. pres. Feb. 1, 1904; clubs—Shenandoah and Country Clubs (Roanoke, Va.), Virginia Club (Norfolk), Queen City (Cincinnati), Racquet Club (Phila.), Tedesco Country (Swampscott, Mass.); add. Roanoke, Va.

JOHNSON, M. O., apptd. supervising architect, Canal Zone, 1904.

JOHNSON, EMORY RICHARD, Canal commissioner; born Wisconsin, Mar. 22, 1864; B. L. univ. of Wisconsin, 1888, M. L. 1891; Ph. D. univ. of Pa., 1893; married Ora L. March of Oshkosh, Wis., Sept. 5, 1894; prof. transportation and commerce, U. of Pa., 1896; expert on transportation, U. S. Industrial Comn., 1899; member U. S. Canal Commission, 1899-1904; expert on transportation, Panama Canal, 1913.

JOHNSTON, WILLIAM C., commr. to rep. Panama in settlement of Canal Zone boundary; ex-asst. chief engr., Repub. Panama; born London, Eng., Nov. 10, 1870; ed. Eng., Belgium and Germ.; went to Panama, 1893; apptd. official engr. for gov. of Panama, 1908; prov. of Cocle, 1909; act. div. engr., 1911.

JUDSON, WILLIAM V., lt. col. Corps of Engrs., U. S. A., asst. div. eng., Canal Zone until Apr. 1, 1914; born Indianapolis, Ind., Feb. 16, 1865; son of Charles E. and Abby (Voorhees) Judson;

ed. Harvard, 1882–4; grad. U. S. Mil. Acad., 1888; U. S. Engr. School Application 1891; married Alice Carneal Clay, of Lexington, Ky., Apr. 21, 1891; add. 2d lt. Eng. Corps., June 11, 1888; 2d lt. July 23, 1888; 1st lt. May 18, 1893; capt. July 5, 1898; maj. Mar. 2, 1906; lt. col., Mar. 2, 1912; recorder, bd. engrs., U. S. A.; instr. mil. engrng. U. S. Engr. School; asst. to ch. engrs.; mil. attaché with Russian Army, Russo-Japanese War; engr. commr. District of Columbia; add. Chicago, Ill.

K

KAGY, LEVI M., mem. Joint Land Comn., The Panama Canal; add. Ancon, Canal Zone.

KITTREDGE, ALFRED BEARD, U. S. senator from South Dak., July 11, 1901, to Mar. 3, 1909; born Nelson, N. H., Mar. 28, 1861; grad. Yale, 1885; adm. to practice law at Sioux Falls, S. D.; hm. Senate Com. on Interoceanic canals, and trong advocate of Panama route; died Hot Springs, Ark., May 4, 1911.

KNAPP, HARRY SHEPARD, capt. U. S. N.; born Conn., June 27, 1856; apptd. naval acad. from Conn., 1874; mem. gen. and joint boards; writer on naval questions; add. Navy Dept., Wash., D. C.

KNOX, PHILANDER CHASE, ex-secy. of state; born Brownsville, Pa., May 6, 1853, son of David S. and Rebekah (Page) Knox; ed. Mt. Union Col., O., Pittsburgh, adm. to bar, 1875; married Lillie, daughter of Andrew D. Smith, Pittsburgh, 1880; atty. gen. in McKinley and Roosevelt cabinets, 1901–4, and visited Paris in negotiations for acquisition of New French Canal Co. titles; apptd. U. S. senator, June 10, 1904, to fill unexpired term of M. S. Quay; elected U. S. senate for term 1905–11; resigned and became secy. of state in Taft cabinet, 1909–13; carried on negotiations with Colombia and tolls question with Great Britain; add. Pittsburgh and Washington.

KYLE, OSCEOLA, judge, Canal Zone, 1904–March 23, 1905.

L

LA GARDE, LOUIS A. col., med. corps., U. S. A., ret.; supt. Ancon hosp., 1904; born April 15, 1849; apptd. asst. surg. June 6, 1879; capt. asst. surg. June 6, 1883; maj. surg. Nov. 13, 1896; lt. col. dept. surg. gen. March 17, 1906; col. Jan. 1, 1910; retired from active service Apr. 15, 1913; add. 2642 Woodley Pl., Washington, D. C.

LANSDOWNE, Fifth Marquis of, (Henry Charles Keith Petty-Fitzmaurice), British secretary of State for foreign affairs 1900, directed negotiations of Hay-Pauncefote treaty.

LANG, A. R., supt. div. of schools, The Panama Canal; add. Ancon, Canal Zone.

LEFEVRE, ERNESTO TISDEL, Minister for Foreign Affairs, Panama; born in Panama, 1876; ed. in U. S.; organized Tel. Co. of Panama, Elec. Light and Ice Supply Co. and Int. Ins. Co. of Panama, Panama Match Co., and other concerns; 1903 apptd. ch. dept. Posts and Telegraphs; Clubs—University, Commercial, International; married Oderay Arango.

LEFEVRE, JOSÉ EDGAR; priv. secy. to Pres. Amador of Panama; now secy. Panama Leg. at Washington; born Panama, Feb. 24, 1881; ed. Panama and U. S.; mgr. Panama Tel. Co.; apptd. clk. Panama R. R. Co.; later asst. gen. paym.; elec. assemblyman prov. Los Santos, 1906; Chev. Legion of Honor of France; mem. Span. Am. Acad. of Arts and Sciences; hon. mem. Geog. Soc. Washington; Clubs—International, Tivoli, Union, University (Panama), Nat. Press. Club, (Washington, D. C.); add. Stoneleigh Court, Washington, D. C.

LePRINCE, JOSEPH A., civ. engr., chief sanitary inspr., Canal Zone until March 25, 1914; born Leeds, Eng., 1875; attended Sachs Col. Inst. New York; grad. Col. U. 1898, C. E.; (M. A. 1899); practiced profession and appointed on Isthmus June 1904; acting health officer City of Panama during yellow fever campaign; married Julia Mercedes Lluria, Havana, 1902.

LEWIS, SAMUEL, mem. Joint Land Comn., The Panama Canal; ed. pub. sch. New York; completed ed. under direction of the Christian Brothers at Passy, France; mem. Municipal Council when Panama was a Dept. of Colombia, apptd. v. p. of that body in 1903; mem. 2d Mixed Com. created by the Hay-Buneau-Varilla treaty; later apptd. secy. of Foreign Affairs during administration of Pres. Obaldia, retaining his post under interim govt. of Pres. Mendoza; temp. in charge Dept. State and of Dept. of Finances and Treasury during administration of Pres. Mendoza; mem. Bd. of Dirs. of National Bank of Panama since 1908; leader of Conservative Progressive party; mem. Fourth Mixed Claim Com., and pres. Municipal Council, City of Panama.

LITTLE, JOSEPH, supt. of constrn. Culebra div., until Feb. 3, 1913.

LLOYD, J. A., American engineer; in 1827 surveyed Panama Canal route.

L'OLONNOIS, FRANÇOIS, French buccaneer; this notable pirate was transported while a youth to the West Indies, where he joined in several filibustering expeditions, as a common mariner. He so distinguished himself by his brute strength and ferocity that the Governor of Tortuga supplied him with a ship to sail on his own account. His success was very great. So enraged was he against Spain that he made an oath never to give quarter to a Spaniard, and he kept his oath, butchering more than a score of prisoners with his own hand on one occasion. In 1660 and 1665 he led expeditions against the west coast of Central America, with some success. He was finally defeated by the islanders near the Gulf of Darien. Killed by Indians 1668.

LOOMIS, FRANCIS BUTLER, diplomat; born Marietta, O., July 27, 1863; son of Judge William H. and Frances (Wheeler) Loomis; ed. Marietta Col.; on ed. staff N. Y. *Tribune*, 1893; married Elizabeth M. Mast, of Springfield, Ohio, Apr. 23, 1897; State Libr. of Ohio, 1886–7; newspaper corres. at Washington, 1887–90; Consul at St. Etienne, France, 1890–93; on return to U. S. apptd. ed. Cincinnati *Tribune;* Minister to Portugal 1897–1901; apptd. asst. secy. State 1901; as Secy. ad interim and as asst. secy. was in charge of questions arising out of the revolution

at Panama. 1905 sent to France as spec. amb. to receive remains of John Paul Jones; grand off. Legion of Honor of France; add., Metropolitan Club, Washington, D. C.

LOULAN, J. A., in charge of lock excavation and trestles, La Boca locks div., 1907; apptd. supt. Ancon quarry and crushers, 4th dist., Pacific div., 1910; born Jamaica, L. I., 1861.

LYSTER, THEODORE C., lt. col. med. corps U. S. A.; born Kans. 1875; grad. Univ. Mich., 1899; ap. from Mich priv. and acting steward hosp. corps, 1898; asst. surg., 1900; capt., 1905; maj., 1909; lt. col., 1915; chief eye, ear and throat clinic, Ancon hospital; later served in Philippines; add. Washington, D. C.

M

MACARTHUR, ARTHUR FREDERIC, engineer, contractor; born Oramel, N. Y., 1860; grad. Harvard, 1882; mar. Mary Seymour Barnum, N. Y., 1889; supt. MacArthur Bros. Co., 1883, gen. mgr., 1892; v. p., 1903, pres. since 1908; int. in other companies; add. 11 Pine st., N. Y.

McILVAINE, CLOYD A., exec. secy., The Panama Canal; born Creston, O., 1877; ed. Wooster Univ. and Normal Univ., Ada, O.; went to isthmus, Dec., 1904.

McKINLEY, WILLIAM, twenty-fifth Pres. of U. S.; born Niles, O., June 29, 1843; enlisted as private soldier in Civil War, mustered out capt. and brev. maj.; member 45th, 46th, 47th, 49th, 50th, and 51st Cong.; gov. of O., 1892–96; elected Pres. of U. S., 1896; reëlected, 1900; assassinated Buffalo, N. Y., Sept., 1901; directed negotiation of first Hay-Pauncefote treaty and otherwise furthered canal projects.

McLEAN, JOHN H., paym., accounting dept., The Panama Canal; add. Empire, Canal Zone.

MAC DONALD, DONALD FRANCIS, geologist, The Panama Canal; went to Isthmus, Jan. 1911; born Pictou Co., Nova Scotia; trav. in Alaska and Brit. Col. for Hudson Bay Fur Co.; grad. Univ. of Wash., 1905; M. S., Geo. Wash. Univ., 1906; field work, Geolog. Survey, 1902–11; add. Culebra, Canal Zone.

MACFARLANE, JAMES, engineer; born Bankfoot, Perthshire, Scotland; went to Isthmus 1901 as superintendent in charge of bridges Panama railroad; member board local inspectors Canal Zone.

MADURO, HENRY L., director of Maduro Co., Panama; born St. Thomas, D. W. I., Aug. 5, 1866; son of Solomon L. and Esther Piza de Maduro; ed. pub. schools, New York City; married Fanny Eder Maduro; entered firm of Maduro é Hijo at Panama in 1886; became a partner in 1892; mem. Union and Univ. Clubs, (Panama); add. Panama City, Panama.

MADURO, JOSHUA L., dir. Maduro Co., Panama; born St. Thomas, D. W. I., son of Solomon and Esther Piza de Maduro; ed. Boltz Col., Hamburg; married Estelle Delvalle, Oct. 1908; mem. firm of Maduro é Hijo, Panama, since Jan. 1884; del. Chamber Com., of Panama, to Phila. Commercial Cong., 1899; resided in London 1894–96; and from 1896 to 1905 in N. Y. City, during which time he became citizen of U. S.; mem. Univ. Club (Panama).

MAGOON, CHARLES E., gov. Canal Zone, May 25, 1905, to Oct. 12, 1906; born Steele Co., Minn., Dec. 5, 1861; son of Henry C. and Mehitable W. (Clement) Magoon; ed. high sch., Owatonna, Minn., Univ. of Neb.; (L.L.D., Monmouth, 1905); unmarried; admitted to bar, 1882; law officer Bu. Insular Affairs, War Dept., 1899–1904; gen. counsel, Isthmian Canal Comn., July 1, 1904–April 1, 1905; mem. Isthmian Canal Comn. 1905–6; Minister to Panama, July 17, 1905–Oct. 12, 1906; provisional gov. Cuba, Oct. 12, 1906–Jan. 28, 1909; Clubs—Metropolitan, Chevy Chase, Alibi, Cosmos (Washington); author, The Law of Civil Government Under Military Occupation, 1902; home, Lincoln, Neb.; add. Metropolitan Club, Washington.

MANN, C. H., depot qmr., supply dept., The Panama Canal; add. Cristobal, Canal Zone.

MANSVELT, English buccaneer; came into prominence on the Spanish Main in 1664, when he led a fleet of fifteen vessels, manned by 500 freebooters of various nativities in an attempt to capture Natá; established pirate settlement on Santa Catarina, leaving it in charge of 100 men; this was to be a rendezvous for pirates, and existed for many years. His attempt on Natá failed, and he undertook an expedition against Cartago, capital of Costa Rica. In this expedition Henry Morgan, afterward so notorious, was second in command. The expedition consisted of French and English, and national prejudices caused so much quarreling that Mansvelt and Morgan had to exercise all their skill and authority to prevent the factions falling on each other. The Governor of Cartago, having received information of the approach of the freebooters, fell on them suddenly with a superior force, driving them back and forcing them to hastily put to sea. Mansvelt sought shelter at Santa Catarina, and died there.

MARKS, DAVID, mem. Joint Land Commn., The Panama Canal; died July 17, 1914.

MASON, CHARLES FIELD, col. Medical Corps, U. S. A., chief health officer The Panama Canal since April 1, 1914; supt. Ancon Hospital, The Panama Canal, since May, 1909; born Richmond, Va., Feb. 27, 1864; ed. pvt. schools and Mil. Acad., Fredericksburg, Va.; son of Wiley Ray and Susan Thornton Mason; married Mary E. Hare, March 4, 1903; apptd. 1st lt., med. corps, May 6, 1886; capt. asst. surg., July 2, 1893; maj. surg., Dec. 9, 1901; lt. col. Jan 1, 1910; col., 1915; served in Spanish-Am. War as maj. and surg. N. J. Vol.; served in Porto Rico and Philippines; asst. surg. gen. 1904–9; author of Handbook for the Hospital Corps, Medical Electricity, Prize Essay for 1910 on "The Medical Department of the Army;" mem. Am. Med. Assn., Assn. Mil. Surgeons U. S.; Citizens' Service Inst., National Geographic Society, Canal Zone Med. Assn., and Texas State Med. Assn.; add., Ancon, Canal Zone.

MAXIM, Sir HIRAM STEVENS, American-English engineer and inventor; born Sangerville, Me., Feb. 5, 1840; invented automatic system of fire-

arms, explosives, etc.; member Vickers' Sons & Maxim; knighted 1901; add. London, Eng.

MAY, WILLIAM HOWARD, marshal, The Panama Canal, since April 1, 1914; born Elkton, Md., 1873; secy. to U. S. Senator A. P. Gorman for sixteen years to 1906; went to Isthmus as secy. to Col. Goethals, 1907, serving until apptd. marshal.

MEARS, FREDERICK, capt. U. S. A., formerly ch. eng., P. R. R. Co.; born Ft. Omaha, Neb., May 25, 1878; ed. pub. sch. N. Y. City and San Francisco; enlisted as private U. S. Army, 1899; apptd. 2d lt., 1901; 1st lt., 1906; capt., 1915; grad. Infantry and Cavalry Sch. at Ft. Leavenworth, 1904, and the U. S. Staff Col., 1905; married April 6, 1907, Jane P. Wainwright; apptd. to Isthmian Canal Comn., May 1906; asst. engr., May 1907; res. eng. for the P. R. R. Co., 1907; chief engr., P. R. R. Co., 1907–9; add. Dept. Interior, Washington, D. C.

MENDOZA, CARLOS A., ex-pres. Panama; born Panama City, Oct. 31, 1856; ed. schools of Panama and Bogotá; secy. of govt. of Gen. Aispuru, 1885; 1897 del. to Liberal Conv. at Bogotá; 1903 apptd. Minister of Justice; 1908 apptd. secy. of property by Pres. Obaldia; assumed presidency of Panama on death of Pres. Obaldia, March 1910.

METCALFE, RICHARD L., mem. Isthmian Canal Comn., Aug. 9, 1913–Mar. 31, 1914; civ. gov., Panama Canal Zone, 1913–14; born Oct. 11, 1861; son of Dr. Richard L. and Ellen T. (Edwards) Metcalfe; ed. pub. schs.; married Bessie Buehler, of Seymour, Ind., Apr. 30, 1885; reporter Omaha *World-Herald*, 1888; asst. to William J. Bryan, editor, 1894; editor *World-Herald*, 1896–05; asst. editor *The Commoner*, 1905–13; apptd. Apr. 1, 1914 mem. committee for formal opening Panama Canal, created by Exec. Order, May 20, 1914; add. Ancon, Canal Zone.

MILLARD, JOSEPH HOPKINS, ex-U. S. Senator; born Hamilton, Can., Apr. 1836; ed. common schools; mar. Carolina Grover Barrows, Davenport, Ia., 1860 (died 1901); res. Omaha since 1856; founded Omaha Nat. Bank, pres. since 1867; ex-mayor Omaha; director U. P. R. R. thirteen years; U. S. Senator 1901–07; chm. Com. on Interoceanic Canals; add. Omaha, Neb.

MONNICHE, T. B., engr. of docks, dept. Operation and Maintenance, The Panama Canal, since Apr. 1, 1914; apptd. eng. in chg. design and construction of aids to navigation, Culebra, Sept. 15, 1908; add. Cristobal, Canal Zone.

MOORE, F. H., asst. engr., charged with the designing of movable dams, Culebra, apptd. Sept. 15, 1908.

MOORE, J. HAMPTON, Member of Congress from Pa., President of Atlantic Deeper Waterways Association since 1907; born Woodbury, N. J., Mar. 8, 1864; married Adelaide Stone in 1899; ed. in common schools; law student in Phila., 1877–80; reporter in the courts on *Public Ledger*, 1881–95; chief clk. to city treas., Phila., 1894–7; editor and pub., 1898–1900; secy. to mayor, 1900; city treas., 1901–3; ch. bu. mfrs., Dept. Com. and Labor, Jan. 1905; resigned to become pres. City Trust Safe Deposit and Surety Co., of Phila.; apptd. by the court, June 24, 1905, receiver of the Co.; pres. Allied Republican Clubs of Phila., 1900–9; pres. Penn. State League in 1900 and reëlected in 1901; elected pres. Nat. Republican League, at Chicago, 1902, and reëlected at Indianapolis, 1904; elected to 59th Cong. for unexpired term; reëlected to 60th, 61st, 62nd, 63rd and 64th Congresses.

MORALES, EUSEBIO A., Minister of Panama to Washington; prime minister of provisional govt., Panama, 1903; born Sinclejo, Colombia, 1865; ed. priv. and pub. schs.; practiced law in Panama, 1887; apptd. judge, 1888; secy. of treas., 1900; Fiscal Commr. to U. S., 1904; apptd. counsel for Panama, assemblyman, 1906–8; secy. of Public Instruction, 1909; married Henriquita Bermudez; add. Stoneleigh Court, Washington, D. C.

MORGAN, Sir HENRY, buccaneer; born in England, 1635; it is said he was kidnapped when a boy and sold into slavery at Barbados. He became a sailor, and in 1666 was captain of one of the vessels in a buccaneering expedition. He soon rose to command of the buccaneers, and performed many daring feats. In Jan., 1671, he organized a buccaneering expedition against the Spanish settlement at Panama. Jan. 18 he defeated the Spanish, captured the city, and secured great booty. Died Aug., 1688.

MORGAN, JOHN T., U. S. Senator from Alabama; born Athens, Tenn., June 20, 1824; pursued an academic course; located in Ala. in 1833; studied law and admitted to bar, 1845; joined the Confederate Army in 1861; commd. col., 1862; apptd. brig. gen. in 1863; after war resumed practice in Ala.; elected as a Dem. to U. S. Senate, 1877; reëlected, 1882, 1888, 1894, 1900, 1906, and served from Mar. 4, 1907, until his death in Washington, June 11, 1907; member Com. on Interoceanic Canals, advocate of Nicaragua route.

MORRIS, R. K., storekeeper, The Panama Canal, since May 1, 1914; add. Balboa, Canal Zone.

MOTSETT, C. H., supt. Panama Railroad; add. Cristobal, Canal Zone.

N

NELSON, HORATIO, British admiral; born Sept. 29, 1758, died Trafalgar, Oct. 21, 1805; organized a force at Jamaica for invasion of Nicaragua, and seized that territory on Atlantic side, which was held by Great Britain, under guise of a protectorate over the Mosquito kingdom, until 1860.

NICHOLS, A. B., office engr., dept. Operation and Maintenance, The Panama Canal; add., Culebra, Canal Zone.

NICUESA, DIEGO de, Spanish commander; born at Baeza, 1465; apptd. gov. of Castilla del Oro, 1508; left Santo Domingo early in 1510 with five ships and about 700 men; suffered shipwreck and great hardships; founded Nombre de Dios; was called to Antigua as governor, but colonists rebelled against him and set him adrift

in a leaky boat; reported to have been eaten by Indians, 1511.

NIÑO, PEDRO ALONSO, Spanish navigator; born in Moguer, Spain, 1455; accompanied Columbus on his third voyage, 1498; later was associated with Cristobal Guerra in an expedition to the pearl coast (Venezuela), leaving Spain in June, 1499, and returning with a rich cargo in April 1500; died, 1505.

NIXON, COURTLAND, maj. 30th inf. U. S. A., dept. qmr. Mount Hope, Canal Zone, and purchasing officer on the Isthmus, 1908–14; born Ft. Brown, army post in Dept. of Texas; ed. pub. and priv. schs., N. Y. and N. J.; grad. Princeton Univ., 1895 (C. E.); apptd. 2d lt. 1st Inf., July 9, 1898; saw service in Cuba and later in Philippines; apptd. capt. Apr. 1904; maj., 1915; married in 1905; add. Plattsburg Bks., N. Y.

NOBLE, ALFRED, canal commissioner; born Michigan, 1844; C. E. univ. of Mich., 1870; married Georgia Speechly, of Ann Arbor, May 31, 1871; supervisor const. various ry. bridges across Mississippi river, 1886-1904; mem. Nicaragua Canal Bd., 1895; mem. Isthmian Canal Comn., 1899-1903; mem. bd. consulting engineers, Panama Canal, 1905.

NOBLE, ROBERT E., lt. col. med. corps, U. S. A., gen. inspr., health dept., Canal Zone, until March 31, 1914; born Nov. 5, 1870; apptd. asst. surg., June 29, 1901; capt. asst. surg. June 29, 1906; maj. med. corps, Jan. 1, 1910; lt. col. 1915; add. Surg. Gen., War Dept., Washington, D. C.

NUTTING, DANIEL C., naval constr. U. S. N., supt. mech. div., dept. Operations and Maintenance, The Panama Canal since Jan. 26, 1914; born Aug. 17, 1869; grad. U. S. Naval Acad.; add. Balboa, Canal Zone.

O

OBALDIA, JOSÉ DOMINGO de, pres. of Panama, 1908–10; born David, Panama, July 30, 1845; ed. Bogotá, Col., and New Haven, Conn.; engaged in business in Panama; his father, José de Obaldia, was President of Colombia; served as Minister to Washington; died Panama City, March 1, 1910.

OBARRIO, NICANOR A. de, first Minister of War and Marine of Panama; born New York, June 3, 1873; apptd. secy. office Register, Dept. of Panama, 1896; apptd. Registrar of Public and Private documents, Dept. Panama, Repub. of Colombia; apptd. prefect prov. Panama, 1902; Minister to Peru, 1908–9; elec. to nat. assembly.

O'GORMAN, JAMES A., U. S. Senator from N. Y., term 1911–17; born N. Y., May 5, 1860; ed. Col. City of N. Y. and N. Y. Univ. (LL.D. Villanova, Fordham, N. Y. Univ., Georgetown Univ.); mar. Anne M. Leslie, of N. Y., 1884; justice Dist. Court, N. Y., 1893–1900; justice Sup. Court, N. Y., 1900–11; chm. Senate Com. on Interoceanic Canals, opposed repeal of tolls exemption; add. 318 W. 108th st., N. Y., and Wash., D. C.

OJEDA, ALONSO de, Spanish adventurer; born in Cuenca, Spain, in 1465; joined Columbus on his first voyage; returning to Spain he interested capitalists in financing a new expedition; on May 20, 1499, accompanied by Americus Vespucci, he sailed with four ships on a voyage of discovery along the coast of South America, and visited Darien, which had already been visited by Bastidas. The Spanish monarch divided Central America into two provinces, making Ojeda governor of one, and Nicuesa governor of the other. This was the first attempt to take possession of the mainland in America. In one of his wars with the natives in 1515 he was wounded by a poisoned arrow, and died in Hispaniola.

ORAM, H. P., supt. northern div., permanent buildings div. since Feb. 18, 1914; add. Culebra, Canal Zone.

OWEN, WESLEY M., judge; born Covell, Ill., 1869; grad. Ill. Wesleyan Univ. 1894; practiced law, member legis.; raised company and was elected captain Sp.-Am. War; married Ora M. Augustine, Normal, Ill., 1904; apptd. judge supreme court, Canal Zone, 1909, served till March 1911.

P

PALMER, AARON H., American contractor; in 1826 contracted with Republic of Central America to build canal through Nicaragua; failed to raise capital and project was abandoned.

PARKER, CHARLES LIBERMANN, quartermaster; born Wash., D. C.; grad. Corcoran Scientific School, 1897; officer Chinese Imperial Maritime Customs, 1901–03; went to Isthmus 1904; chief clerk quartermaster's dept.; supt. labor quarters and subsistence Gorgona dist.; inspr. quartermaster's dept.; asst. depot qtrm., Mount Hope, 1909.

PARSONS, WILLIAM BARCLAY, civil engr., mem. Isthmian Canal Comn., 1904; mem. bd. consulting engineers, Panama Canal, 1905; born New York, April 15, 1859; son of William Barclay and Eliza Glass (Livingston) Parsons; A. B., Columbia, 1879, C. E., 1882; (LL.D., St. Johns, Md., 1909); married Anna DeWitt Reed, of New York, May 20, 1884; in gen. practice as engr., chief engr., Rapid Transit Comn. of New. York, 1894–1905; advisory engr. Royal Comn. London Traffic, 1904; brig. gen., Chief of Engrs., N. G. S. N. Y.; trustee Columbia Univ. since 1897; mem. Am. Soc. C. E., Instn. Civ. Engrs., Great Britain; author, Track, 1885; Turnouts, 1885; An American Engineer in China, 1900; add., 60 Wall st., New York.

PASCO, SAMUEL, canal commissioner; born London, Eng., June 28, 1834; removed to Mass.; A. B., Harvard, 1858, A. M., 1872; taught school; non-commd. officer C. S. A., 1861-65; married Jessie Denham of Monticello, Fla., Oct. 28, 1869; practiced law; mem. Florida Ho. of Rep., 1886-87; U. S. Senator, 2 terms, 1887-99; mem. Isthmian Canal Comn., 1899-1904.

PATERSON, WILLIAM, Scottish adventurer; born in Dumfriesshire, April 1658; in 1695 Scottish Parliament authorized Paterson to plant colonies. A charter was obtained from William III, and a company formed to settle a colony on Isthmus of Darien, to which was given the name

of New Caledonia. On July 26, 1698, Paterson sailed with 1500 colonists, and founded a settlement called New Edinburgh in the port of Acla. After experiencing most terrible suffering the colony was abandoned in 1699. Paterson was the originator of the plan of the Bank of England; died, 1719.

PAUNCEFOTE, Sir JULIAN, Lord Pauncefote, British diplomat; born Sept. 13, 1828; died Washington, May 24, 1902; knighted, 1874, raised to peerage as Baron Pauncefote, 1899; Brit. Min. to U. S., 1889–93; ambass. 1893–1902; conducted negotiations for settlement of Behring Sea controversy, Anglo-Venezuelan boundary question, etc.; signed Hay-Pauncefote treaty; participated in negotiations for neutralization of Suez Canal, 1885.

PEDRARIAS DAVILA (real name Pedro Arias de Ávila); born in Segovia, Spain, in 1440. He distinguished himself in the conquest of Granada; in 1514 apptd. gov. of Panama, and on arrival found a rival in Balboa, who had recently discovered the Pacific Ocean. At first made friends with Balboa, but later accused him of plotting against him and the Spanish crown, and caused him to be executed in 1517. This execution caused him to lose favor in Spain, and not long afterwards he was removed from the governorship; died in Nicaragua in 1530.

PEPPERMAN, W. LEON, chief of administration, Canal Zone, under Chm. Shonts; active in securing labor for canal; formerly asst. chief insular bureau, War dept.; now asst. to Pres., Interborough R. T. Co., N. Y.

PERRY, JAMES CLIFFORD, surg., U. S. M. Hosp. Ser., ch. quarantine officer since 1905; born N. C.; ed. Univ. of N. C. and Univ. of Md.; pres. Canal Zone Med. Assn.

PEYNADO, FRANCISCO J., late minister of the Dominican Republic to the U. S.; born Puerto Plata, Oct. 4, 1867; son of Gen. Jacinto and Carolina (Huttlinger) Peynado; married 1893, Carmen Gonzalez; for twenty years was in active practice of law, and during that time wrote several works connected with Dominican affairs; was three times president of city council of Santo Domingo, and three times president of National Bar Association of Dominican Republic; member of National Board of Education, counsellor of Public Works, etc.; editor and prop. *Las Novedades*, New York City.

PHILLIPS, JOHN L., brig. gen. med. corps., U. S. A., supt. Ancon hosp., 1905–07; asst. ch. sanitary officer until March 31, 1914; born April 1, 1859; apptd., asst. surg., Dec. 3, 1883; capt. asst. surg., Dec. 3, 1888; maj. med. corps, Oct. 8, 1900; lt. col., Dec. 12, 1908; col. April 13, 1912; brig. gen., 1915; commdg. Walter Reed Gen. Hosp., Takoma Park, D. C.

PIERCE, CLAUDE CONNOR, surg., Marine Hosp. Ser., quarantine officer, Colon, since 1905; born Chattanooga, Tenn., 1878; ed. Chat. Med. Col.; priv. and 1st lt., hosp. corps, Sp.-Am. War; in charge Tampa Bay quar. sta., 1901–03; went to Isthmus Jan. 1904, and took charge quar. work, Panama; exec. officer for chief sanitary officer, 1905.

PINZON, MARTIN ALONSO, shipbuilder and navigator of Palos Spain; born there, 1441; commanded the *Pinta*, one of Columbus's caravels, in voyage of 1492; discovered Haiti; was separated from Columbus by a storm, and reached Bayona, in Galicia, whence he despatched a letter to Ferdinand and Isabella announcing his discovery; proceeded to Palos, arriving on same day as Columbus, March 15, 1493; died Palos, 1493.

PINZON, VICENTE YAÑEZ, brother of Martin Alonso Pinzon, born at Palos, 1460; commanded the *Niña* in Columbus's first voyage; commanded four ships sailing from Palos, Dec. 1499, and was first Spanish navigator to cross the equator, reaching Brazil and discovering the mouth of the Amazon; associated with Juan Diaz de Solis in exploring Gulf of Honduras, 1506; died Palos, 1524.

PIZARRO, FRANCISCO, Spanish adventurer; born at Trujillo, Estremadura, Spain, 1470; in 1509, with other adventurers he sailed for America; joined Balboa in his expedition to discover the South Sea, and was one of his trusted lieutenants; was engaged in several other expeditions, and in 1519 settled at the new city of Panama. There he organized and conducted a number of expeditions searching for gold, and in 1528, Charles V. gave him authority to conquer and govern Peru. His cruelty and rapacity made him many enemies, and on Sunday, June 26, 1541, he was assassinated while eating his dinner.

PORRAS, BELISARIO, President Republic of Panama since Oct. 1, 1912; born Las Tablas, Prov. of Las Santos, Panama; married Alicia Castro, of San José, Costa Rica, 1911; received early education in private school at Las Tablas; graduated in law from Nat. Univ. of Bogotá, Colombia, and pursued further course of study at Free Univ. of Brussels; practiced law in Panama, 1885–96; secy. to Circuit Judge of Panama; Consul Gen. of Colombia at Brussels, and later attaché of legation of Colombia at the Quirinal; counsellor of Nicaragua; pres. Municipal Council in Panama City, 1905–6; delegate to Nat. Assembly of Panama; delegate of Panama to The Hague Conference, 1907; served as Minister of Panama at Rio de Janeiro, Minister at San José, Costa Rica, Minister on Special Mission to Washington, D. C.; delegate of Panama to International Sanitary Conference at Buenos Aires, 1910; Minister to the U. S., 1911.

PRICE, WILLIAM JENNINGS, diplomat; born Lancaster, Ky., 1873; home, Danville, Ky.; grad. Centre Col., 1895; pros. atty. Boyle Co., Ky., 1901–09; apptd. U. S. Minister to Panama, Aug. 20, 1913; add., Panama.

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QUALQUOJOU, CAMILO, born David, Chiriqui, Republic of Panama, May 9, 1866; son of Adolfo and Antonina Arauz de Qualquojou; ed. Eastman Col., Poughkeepsie, N. Y.; married, Jan. 10, 1895, Julia de Roux; 1885–95 clerked for the firm of Guardia é Qualquojou; 1895–1900 partner of firm; 1901 founded firm of C. Qualquojou é

Co., firm dissolving in 1912, when he continued business under his own name.

R

RANDOLPH, ISHAM, civil engineer; born New Market, Va., Mar. 25, 1848; ed. private schools; engineering acquired by study and actual work; engineer various railroads, 1882-1907; mem. Internat. Bd. of Consulting Engrs. for Panama Canal, 1905-06; Advisory Bd. Engrs. Panama Canal, 1907; res., Chicago, Ill.

REDFERN, SAMUEL EDWARD, temp. secy., Chief Clerk, Disburs. Off., and purchasing agent, Isthmian Canal Comn.; born Washington, D. C., Oct. 14, 1865; son of Joseph and Josephine Redfern; ed. Georgetown Univ.; married Marie Holcombe Moore, Aug. 1899; apptd. chief clk. Nicaragua Canal Comn., under Rear Admiral Walker, later chief clk., Isthmian Canal Comn.; afterwards apptd. U. S. Comr. Immigration, New Orleans, La.

REEDER, D. F., physician; born Ky.; grad. Univ. of Louisville, 1905, as M.D.; went to Isthmus, 1906, as asst. to chief of eye, ear, nose and throat clinic; apptd. chief, 1909.

RERDELL, MONTFORT C., Sr. Dist. Judge, Canal Zone; born Ala.; went to Canal Zone, Aug. 1904; on staff of Gov. George W. Davis; apptd. Sr. Dist. Judge, 1907.

REYNOLDS, WILLIAM T., constructor; born Elk Ridge, Md.; went to Isthmus, 1906, as asst. supervisor; apptd. supervisor and asst. supt. of construction; apptd. supt. of construction, 1908.

RIPLEY, JOSEPH, mem. International bd. of consulting engrs. of Panama Canal; born St. Clair, Mich., 1854; pub. sch. ed.; U. S. asst. engr. Sault St. Marie canal, 1877; consulting engr. various canal projects in U. S., 1877-1906; mem. int. bd. consulting engrs. of Panama Canal, 1905; prin. asst. engr. Panama Canal in charge of designing locks, dams, and regulating works, and asst. chief engr. Panama Canal, 1906-1907.

ROBINSON, ARTHUR L., elec. eng., Canal Zone, 1905–14; supt. mech. div., dept. constrn. and engrg., Gorgona, 1910–13; born in Ky.; ed. pub. sch.; grad. Rose Poly. Inst., Terre Haute, Ind., 1895; entered employ Southern Ry. and at time of appt. to Canal Zone was electrical engr. for entire Southern Ry. system.

RODMAN, HUGH, capt. U. S. N., supt. transportation, Div. Canal Transportation, The Panama Canal, since April 1, 1914; born Jan. 6, 1859; add., Ancon, Canal Zone.

ROGERS, RICHARD REID, apptd. general counsel Isthmian Canal Comn., July 1, 1906.

ROOSEVELT, THEODORE, twenty-sixth pres. of U. S.; born New York, Oct. 27, 1858; son of Theodore and Martha (Bulloch) Roosevelt; A. B. Harvard, 1880; (LL.D. Columbia, 1899, Hope Coll., 1901; Yale, 1901; Harvard, 1902; Northwestern, 1903; Univ. of Chicago, 1903; Univ. of Cal., 1903; Univ. of Pa., 1905; Clark Univ., 1905; George Washington Univ., 1909; Cambridge Univ., 1910; D.C.L., Oxford Univ., 1910; Ph.D., Univ. of Berlin, 1910); married Alice Hathaway Lee, Oct. 27, 1880 (died Feb. 14, 1884); married Edith Kermit Carew, of New York, Dec. 2, 1886; mem. N. Y. Legis., 1882–4; del. Rep. Nat. Conv., 1884; U. S. Civil Service Commr., 1889–95; pres. N. Y. Police Bd., 1895–7; asst. secy. navy, 1897–8; resigned to organize with Surg. (now Maj. Gen.) Leonard Wood, 1st U. S. Cav.; promoted colonel for gallantry at battle of Las Guasimas; mustered out Sept. 1898; Gov. New York, Jan. 1, 1899–Dec. 31, 1900; elected V. P. of U. S., Nov. 4, 1900, succeeded to Presidency on death of William McKinley, Sept. 14, 1901; elec. President of the U. S., Nov. 8, 1904; Progressive Party candidate for President, 1912; contributor to magazines and reviews; add., Oyster Bay, N. Y.

ROOT, ELIHU, some time Secretary of War, Secretary of State, and U. S. Senator; born Clinton, N. Y., Feb. 15, 1845; son of Prof. Oren and Nancy Whitney (Butterick) Root; A. B., Hamilton Col., 1864, A. M., 1867; taught at Rome Acad., 1865; LL.B., New York Univ., 1867; (LL.D., Hamilton, 1894; Yale, 1900; Columbia, 1904; New York Univ., 1904; Williams, 1905; Princeton, 1906; Univ. of Buenos Aires, 1906; Harvard, 1907; Wesleyan, 1909; McGill, 1913); married Clara Wales, of New York, Jan. 8, 1878; U. S. Dist. Atty. for Southern Dist. of New York, 1883–5; mem. Alaskan Boundary Comn, 1903; apptd. Secy. of War, Aug. 1, 1899; apptd. Secy. of State, July 7, 1905, and negotiated and signed Root-Cortes and Root-Arosemena treaties; U. S. Senator, 1909 to 1915; apptd. mem. Permanent Bd. of Arbitration at The Hague, 1910; add., New York City.

ROSE, WILLIAM H., maj. Corps of Engrs., U. S. A., elec. engr., dept. Operation and Maintenance, The Panama Canal; born Oct. 24, 1881; grad. U. S. Mil. Acad., 2d lt. eng., June 11, 1903; 1st lt., June 13, 1904; grad. Engineer Sch., 1907; capt. Feb. 27, 1911; maj., 1915; add., Balboa, Canal Zone.

ROSS, DAVID W., chief purchasing dept., Isthmian Canal Comn., 1906; vice-p. Interborough Rapid Transit Co., N. Y.; add., 165 Broadway, New York.

ROSS, JOHN W., med. dir., U. S. N., dir. of hospitals, stationed at Ancon, 1904; retired from active service, Jan. 11, 1905.

ROURKE, LOUIS KEEGAN, commissioner of Public Works, Boston, Mass., since Feb. 1911; born Abington, Mass., Nov. 23, 1873; son of Peter and Margaret Rourke; married Teresa M. Ryan, Jersey City, N. J., May 1907; grad. Abington pub. sch. and Mass. Inst. of Tech. (bachelor of science and civil engineer), 1895; with Boston & Maine R. R., 1895–7; supervisor of tracks Panama railroad, 1897–9; supt. constrn. and contractor Guayaquil & Quito R. R., Ecuador, 1899–1903; contr. for Mass. highway comn., 1903–5; supt. tracks and dumps, asst. div. engr., div. engr., all on Culebra div., Panama Canal; organized central div. by combining Culebra and Chagres, and at time of resignation was asst. div. engr., central div., in charge of construction, 1905–10; supt. of streets, Boston, 1910; Clubs—University, Panama; Boston City, Dorchester, Technology of New York; mem. Am. Soc. Civil

Engrs., Boston Soc. Civil Engrs.; add., City Hall, Boston, Mass.

ROUSSEAU, HARRY H., civ. engr., U. S. N., engr of Terminal Construction, The Panama Canal, since April 1, 1914; born Troy, N. Y., April 19, 1870; son of William White and Jeanette Parker Rousseau; married Gladys Fargo Squires, New York, 1908; C. E., Rensselaer Poly. Inst., 1891; draftsman and engr. for pvt. cos., 1891–8; apptd. after competitive exam., civ. engr., U.S.N., rank of lt., 1898; engr. Bureau Yards & Docks, Washington, 1899–03; engr. pub. improvements, Mare Island navy yard, Cal., 1903–7; apptd. chief Bureau Yards and Docks, with rank of rear admiral, Jan., 1907; mem. Isthmian Canal Comn., March 16, 1907–March 31, 1914; dir. Panama R. R. Co.; apptd. civil eng. in navy with rank of rear admiral of the lower nine, March 4, 1915; mem. Rensselaer Soc. of Engrs., Engrs. Soc. of Western Pa.; asso. mem. Am. Soc. C. E.; Clubs—Army and Navy, Metropolitan, Chevy Chase (Washington); add., Culebra, Canal Zone.

RUGGLES, GEORGE H., apptd. to civil administration dept., Cent. Div., Canal Zone, 1909; grade changed to supt. of municipal work, Centl. Div., Canal Zone, Sept. 1, 1909; began canal service, 1904, as instrument man with survey party; born Bloomingdale, Mich.; ed. Lehigh Univ.

RUGGLES, W. B., asst. engr. La Boca dams div., since 1904.

S

SANDS, ROBERT MARCENA, chief clk. Atlantic div., Canal Zone; born Ala., 1876; apptd. secy. to chief of dept. Lock and Dam Const., April, 1907; apptd. chief clerk Atlantic div., July, 1908.

SAUNDERS, WILLIAM LAWRENCE, engineer, president, and director The Ingersoll-Rand Co., New York, N. Y.; Ingersoll-Sergeant Drill Co.; Rand Drill Co.; New York Imperial Tool Co.; director of A. S. Cameron Steam Pump Works; Edison-Saunders Compressed Air Co.; International Harvester Co.; International Pneumatic Tube Co.; born Nov. 1, 1856, Columbus, Ga.; son of Rev. Dr. W. T. and Eliza Morton Saunders; married Bertha Louise Gaston at Narragansett Pier, R. I., Aug. 4, 1886 (died 1906); ed. Univ. of Pa. (B. S. Univ. of Pa., 1876; D.Sc., Univ. of Pa., 1911); in charge of hydrographic work, 1878; and subaqueous rock excavation, 1879–81; National Storage Co., Communipaw, N. J.; invented apparatus for drilling rock under water, Ingersoll track and bar channelers and gadders for quarrying stone; twice elected mayor of North Plainfield, N. J.; mem. Am. Inst. Mining Engrs.; Am. Soc. Civil Engrs.; Am. Soc. Mech. Engrs.; Nat. Civic Federation; N. Y. Chamb. Com.; Nat. Geog. Soc.; ed. *Compressed Air Magazine;* author "Compressed Air Information," "Compressed Air Production;" co-author "The Subways, and Tunnels of N. Y.;" "Dana and Saunders' Rock Drilling;" Clubs—Engineers', Machinery, Economic, Aero of America; add., 11 Broadway, New York.

SAVILLE, CALEB MILLS, civil engineer; born Melrose, Mass.; grad. Harvard; married Elizabeth Thorndike, 1891; asst. city engr. Malden, Mass., 1891–95; div. engr., Mass. met. water comn., 1895–96; helped to build Wachusett dam; went to Isthmus, Aug., 1907, in charge of investigation for foundation and methods of construction of dams at Gatun and other places; in charge of questions of seepage and matters connected with water supply of Gatun lake; investigator of meteorology and hydrology in connection with canal work; surveyed drainage basin Chagres river and Canal Zone lands.

SCHAFER, GEORGE C., paym. U. S. N., disbursing officer on Isthmus, 1904; apptd. treas. of Zone, 1905; add., Norfolk, Va.

SCHIAVONI, MARIO J., architect, permanent building div., Supply Dept., The Panama Canal, until Dec. 5, 1913.

SCHILDHAUER, EDWARD, electrical and mech. engr.; born New Holstein, Wis.; grad., 1897, Univ. of Wis.; apptd. elec. and mech. engr. to Isthmian Canal Comn., Nov. 1906; invented special devices in connection with miter gates; designed "electric mule" to convey ships through locks; designed system for controlling all lock machinery from central station; designed Gatun and Miraflores power plants; made special investigations of principal canals in England, France, Belgium, Holland, and Germany.

SESSIONS, ARTHUR, apptd. supt. of transportation, Central div., July 11, 1908; had charge of all trains moving dirt from Culebra Cut; born Macon, Miss.; went to Isthmus as trainmaster, 1905; asst. supt., 1906.

SHANTON, GEORGE R., apptd. chief of police, Canal Zone, 1905.

SHARP, BARTHOLOMEW, English buccaneer; in 1680 endeavored, with a large force, to swoop down on Panama and capture the gold fleet, but was induced by a native cacique to attempt a raid on Santa Maria. The raid was successful in capturing the town and the garrison, but they found little booty. This so enraged the freebooters that they slaughtered their prisoners. Sharp pushed on to Panama, where he was attacked by three Spanish war vessels. He captured all three, but was finally driven off. Later he was tried in London for piracy and acquitted.

SHERMAN, EDWARD C., civil engr.; born Kingston, Mass., 1877; grad. Mass. Inst. Tech., 1898; engaged in designing Cambridge bridge, Cambridge-Boston, 1900–3; designed river improvements vicinity of Boston, 1905–9; went to Isthmus, 1909, engaged in designing dams and spillways; married Kathrine Buck, 1907.

SHONTS, THEODORE P., chairman Isthmian Canal Commission, 1905–7; president Interborough Rapid Transit Co., N. Y.; born Crawford Co., Pa., May 5, 1856; son of Dr. Henry Daniels and Margaret Nevin Marshall Shonts; removed with parents in boyhood to Ia.; married Harriet Amelia, daughter of Gen. (afterwards Gov.) Francis M. Drake, of Centerville, Ia., 1882; A. B., Monmouth (Ill.) Col., 1876; after graduation became an accountant and employed by nat. banks in Ia. to standardize and simplify methods of bookkeeping; studied law and prac-

ticed a short time at Centerville; became associated with Gen. Drake, who had large financial and railroad interests, and who placed much of the work of management and constrn. in his hands; had charge of constrn. of Ia. Cent. R. R., afterwards built the Mo., Ia. & Neb. R. R., and later the Ind., Ill. and Ia. R. R. and was its controlling owner, later selling it to the L. S. & M. S. R. R. Co.; with others secured control of Toledo, St. Louis and Western R. R., which he rehabilitated and made successful; selected by Pres. Roosevelt as chmn. of Isthmian Canal Comn.; pres. Interborough Met. Co., Toledo, St. Louis and Western R. R. Co., C. & A. R. R. Co., Minneapolis & St. Louis R. R. Co., Ia. Central R. R. Co., since Feb. 1907; add., 165 Broadway, New York.

SHONTZ, G. M., pros. atty., Canal Zone, until April, 1910.

SIBERT, WILLIAM LUTHER, brig. gen. Corps of Engrs., U. S. A., mem. Isthmian Canal Comn., and div. engr. Atlantic div. Isthmian Canal Comn. in charge of constrn. Gatun Locks and Dam, Breakwaters, Colon Harbor, etc., April 1, 1907–April 1, 1914; born Gadsden, Ala., Oct. 12, 1860; son of William J. and Marietta Ward Sibert; married Mary Margaret Cummings of Brownsville, Tex., Sept., 1887; ed. Univ. of Ala., 1878–80; grad. U. S. Mil. Acad., 1884; apptd. 2d lt. of engrs., June 15, 1884; grad. Engr. Sch. of Application, 1887; 1st lt., April 7, 1888; capt., March 31, 1896; maj., April 23, 1904; lt. col., 1909; brig. gen., March 4, 1915; asst. engr. river work in Ky., 1887–92; in charge of constrn. ship channel connecting Great Lakes, 1892–4; in charge engring. river and harbor dist. (Ark.), 1894–8; instr. civ. engring., Engr. Sch. of Application, 1898–9; chief engr. 8th Army Corps, and chief engr. and gen. mgr. Manila & Dagupan R. R., 1899–1900; in charge engring. river and harbor dists. (headquarters Louisville and Pittsburgh) 1900–7; mem. Engrs. Soc. of Western Pa., Am. Soc. C. E.; comdg. Pacific coast artillery dist.; add. Ft. Miley, Cal.

SLIFER, H. J., gen. mgr., P. R. R. Co., 1908–9.

SMITH, H. A. A., auditor, The Panama Canal, since April 1, 1914; apptd. exam. accounts, Canal Zone, May 12, 1911; add. Empire, Canal Zone.

SMITH, J. A., supt. P. R. R. Co. beginning 1909; began railroading on Penna. R. R. as teleg. opr. at Mill Creek, Pa., 1881; pres. Colon Club.

SMITH, JACKSON, mem. Isthmian Canal Comn., March 1, 1907–Sept. 15, 1908; in charge of labor recruiting under Chm. Shonts and Ch. Eng. Stevens; chief dept. labor and quarters.

SMITH, RAY LOW, chf. appt. div., The Panama Canal, since 1904; born Braidwood, Ill., Jan. 5, 1877; son of Theodore T. and Lucy O. Smith; married Alice Bates, Braceville, Ill., Dec. 31, 1901; grad. scientific course Valparaiso (Ind.) Col., 1899; Ind. Univ., 1899–1900; supt. schools, Braceville, Ill., three years; clk. U. S. Govt. service, 1903; add., The Panama Canal, Washington, D. C.

SNEED, J. W., supt. Chagres section P. R. R. to Aug. 19, 1912; born Memphis, Tenn.; went to Isthmus, 1906, as conductor; promoted to supt. Bas Obispo dist., 1907, Chagres section, 1910.

SOLIS, JUAN DIAZ de, Spanish navigator; born at Lebrija, Spain, 1470; associated with Vicente Pinzon in explorations of Honduras, Yucatan and South American coast; apptd. chief pilot of Spain, 1512; sailed in 1515 to seek southwestern route to the Pacific; entered Rio de la Plata and was killed by Indians, 1516.

SPOONER, JOHN COIT, author of act of Congress under which Panama Canal was acquired and constructed; born Lawrenceburg, Ind., Jan. 6, 1843; son of Judge Philip L. and Lydia Coit Spooner; married Amie E. Main, of Madison, Wis., Sept. 10, 1868; removed to Madison, Wis., 1859; A. B., Univ. of Wis., 1864; (hon. Ph.B., A.M., 1869, LL.D., 1895; LL.D., Yale, 1908; Columbia, 1909); served pvt. Co. A., Wis. Inf.; pvt. and mil. secy. to Gov. Lucius Fairchild, of Wis., 1866–7; admitted to bar, 1867; asst. atty. gen. of Wis., and in general practice at Madison, 1867–70; practiced at Hudson, Wis., 1870–84; regent of Univ. of Wis., 1882–5; mem. Wis. Assembly, 1872; U. S. Senate, 1885–91, and 1897–1907; resigned March 3, to take effect May 1, 1907; since in law practice at New York; chm. Wis. delegation Rep. Nat. convs., 1888, 1892; candidate for gov. of Wis., 1892; tendered portfolio of Sec. of the Interior by Pres. McKinley, 1898; Brit.-Am. Joint High Comn., 1898, and Atty. Gen. of U. S., 1901, but declined; add., 14 Wall st., New York.

SPRATLING, L. W., med. inspr., U. S. N., supt. Colon hosp., 1904; add. Navy Recruiting Sta., Atlanta, Ga.

STANTON, F. C., asst. engr., Chagres div., since Sept. 25, 1907.

STEARNS, FREDERICK PIKE, mem. international board consulting engineers on Panama Canal; born Calais, Maine, 1851; hon. A. M., Harvard, 1905; D. Sc., Univ. of Pa., 1906; married Addie C. Richardson, of Framingham, Mass., June 21, 1876; chief engr. Mass. Met. water works, 1895-1907; mem. bd. of consulting engrs. Panama Canal, 1907-1909.

STEPHENS, JOHN LLOYD, organized Panama Railroad Company with Wm. H. Aspinwall and Henry Chauncey, and was first v. p., and later pres. of co.; born Shrewsbury, N. J., Nov. 28, 1805; ed. Columbia Col.; practiced law in New York; 1839 apptd. special agent of U. S. to Central America by Pres. Van Buren; assisted in establishing first line of steamers between New York and Bremen; died in New York City Oct. 10, 1852; monument erected to him on highest point of Panama Railroad.

STERNS, F. E., asst. engr., lock gates and protective works; mem. staff Washington Off., Isthmian Canal Comn., until Oct. 1908, then transferred to Canal Zone.

STEVENS, JOHN F., chief engr., Panama Canal, 1905–April 1, 1907, and chm. Isthmian Canal Comn., Feb.–March, 1907; born Gardiner, Maine, April 25, 1853; son of John and Harriet Stevens; married Harriet T. O'Brien, Dallas, Tex., Jan. 6, 1887; asst. engr., City of Minneapolis, 1874–6; ch. engr., Sabine Pass and

Northwestern Ry., 1876–9; asst. engr., D. & R. G. Ry., 1879–80; C., M. & St. P. Ry., 1880–2; div. engr., Canadian Pac. Ry., 1882–6; asst. engr., C., M. &. St. P. Ry., 1886; prin. asst. engr., Duluth, South Shore & Atlantic Ry., 1887–9; asst. engr. Spokane Falls & Northern Ry., 1889; prin. asst. engr., 1889–93; asst. chief engr., 1893–5, chief engr., 1895–1902; gen. mgr., 1902–3, G. N. Ry.; chief engr., 1903–4; 2d v. p. 1904–5, C., R. I. & P. Ry. Co.; v. p., N. Y., N. H., & H. R. R., in charge operation, 1907–9; pres. Spokane, Portland & Seattle Ry., Ore. Electric Ry., Oregon Trunk Ry., Pacific & Eastern Ry., 1909–11; mem. Am. Soc. C. E.; add., 45 Wall st., New York.

STICKLE, H. W., maj. Corps of Engrs., U. S. A.; born Anamosa, Iowa; grad. West Point, 1899; apptd. asst. div. engr. Gatun locks div., 1907; asst. engr., Atlantic div., 1909.

STIMSON, HENRY L., born New York, Sept 21, 1867; son of Lewis Atterbury and Candace (Wheeler) Stimson; A.B., Yale, 1888; A.M., Harvard, 1889; Harvard Law Sch., 1889–90; married Mabel Wellington White of New Haven, 1893; admitted to bar, 1891; U. S. atty. Southern Dist., N. Y., 1906–9; Rep. candidate for Gov. N. Y., 1910; Secy. of War in Cabinet of Pres. Taft, May, 1911–March 5, 1913, and active in supervising affairs of Panama Canal; add. 32 Liberty st., New York.

STONE, A. K., railroad man; born Ind.; common sch. ed.; brakeman, conductor, train master, etc., on various railroads; went to Isthmus, 1905, as train master central div., 1910; master of transportation, Panama R. R.

STRICKLAND, G. B., res. engr., 1st dist., dept. of Constrn. and Eng., Corozal, until April 1, 1909.

STROM, CARL E., ch. mech. engr., Canal Zone, 1904; apptd. supt. motive power and machinery, Canal Zone, 1905.

SULLIVAN, J. G., first asst. engr. under Ch. Eng. Stevens; chief engr. Canadian Pacific Ry.

T

TAFT, WILLIAM HOWARD, twenty-seventh President of United States; official head of Isthmian affairs as Secy. of War under Pres. Roosevelt; born Cincinnati, Ohio, Sept. 15, 1857; son of Alphonso and Louisa Maria (Torrey) Taft; grad. Woodward High Sch., Cincinnati, 1874; B.A., Yale, 1878; LL.B., Cincinnati Law Sch., 1880; (LL.D., Yale, 1893; Univ. of Pa., 1902; Harvard, 1905; Miami Univ., 1905; State Univ. of Ia., 1907; Wesleyan, 1909; Princeton, 1912; McGill Univ., 1913; D.C.L., Hamilton, 1913); married Helen Herron, Cincinnati, June 19, 1886; admitted to Ohio bar, 1880; law reporter, Cincinnati *Times*, and later of Cincinnati *Commercial*, 1880; asst. pros. atty., Hamilton Co., O., 1881–3; practiced law at Cincinnati, 1883–7; judge, Superior Ct., Cincinnati, 1887–90; sol. gen. of U. S., 1890–2; U. S. circuit judge, 6th circuit, 1892–1900; pres. U. S. Philippine Comn., 1900–1; first civ. gov. P. I., 1901–4; sent to Cuba by Pres. Roosevelt to adjust insurrection there, 1906, and acted for short time as prov. gov.; elec. President of U. S., for term 1909–13; professor of law, Yale Univ.; add. New Haven, Conn.

TENNEY, M. W., asst. engr., supt. constrn. Culebra, Canal Zone, since Feb. 3, 1913.

THATCHER, MAURICE HUDSON, mem. Isthmian Canal Comn., April 12, 1910–Aug. 8, 1913; head dept. civil administration, Canal Zone, May 13, 1910–Aug. 8, 1913; born Chicago, Ill., Aug. 15, 1870; son of John C. and Mary T. (Graves) Thatcher; ed. pub. and pvt. schools, Ky.; studied law at Frankfort, Ky., 1896–8; married Annie Bell Chinn, of Frankfort, May 4, 1910; admitted to Ky. bar, 1898; asst. atty. gen. of Ky., 1898–1900; asst. U. S. Atty. for Western Dist. of Ky., 1901–6; in gen. practice, Louisville, 1906–10; state inspr. and examr. for Ky., 1908–10; practicing law at Louisville; add., Paul Jones Bldg., Louisville, Ky.

THOM, LESLIE GRANT, civil engr.; connected with municipal improvements, Colon and Panama; supt. municip. eng., Atlantic div., Gatun.

THOMPSON, JOHN W., magistrate, The Panama Canal, since April 1, 1914; add., Cristobal, Canal Zone.

THOMSON, THADDEUS AUSTIN, diplomat; born Burleson Co., Tex., 1853; home, Austin, Tex.; ed. Salado Col., Tex. Mil. Inst.; ad. to bar, 1883; planter, ranch owner; apptd. Minister to Colombia, June 10, 1913; negotiated and signed treaty with Colombia.

THURSTON, LORRIN ANDREWS, lawyer; born Honolulu, H. T., 1858; grad. Columbia Law Sch., N. Y.; married Harriet Potter, St. Joseph, Mich., 1894; Min. Interior, Kingdom of Hawaii, 1887–90; mem. House of Nobles, 1892; Mem. Com. of Safety, 1893; mem. Advisory Council, prov. govt., 1893; Spl. Comr. to U. S to negotiate annex., 1893; Min. to U. S., 1893; Min. of Haw. Republic to U. S., 1894; to Portugal, 1894; Spl. Comr. to U. S. to negotiate treaty of annex., 1897; pres. Hawaiian *Gazette* Co., Olaa Sugar Co.; int. in other companies; author; res., Honolulu, H. T.

TOBEY, E. C., paym., U. S. N., apptd. ch. dept. material and supplies, Canal Zone, 1904–07; later in Bu. Supplies and Accounts, Navy Dept., Washington, D. C.

TUCKER, HERMAN FRANKLIN, apptd. designing engr. dept. of lock and gate and dam constrn., Culebra, 1907; apptd. designing engr. masonry and lock design, at Culebra, 1908; born Weston, Mass., 1878; grad. Harvard, 1901; engr. for Dominion Eng. & Constrn. Co., Montreal, 1906.

V

VALDÉS, RAMON M., late Minister of Panama to Washington; ed. at Cartagena; rep. of Panama in Colombian Cong.; later secy. of Public Education; practiced law; apptd. Secy. of State and of Justice by Pres. Obaldia, and continued during interim term of Pres. Mendoza; apptd. Panama's spec. del. to the Hudson and Fulton Centennial Celebration at New York, 1909; apptd. Minister to Washington by Pres.



BUILDINGS OF THE UNIVERSITY OF PENNSYLVANIA, WHERE MANY MEN WHO WORKED ON THE CANAL AND WHO SUPPLIED EQUIPMENT, RECEIVED THEIR SCIENTIFIC TRAINING

1. Provost Edgar F. Smith.
2. Engineering building.
3. Harrison laboratory of chemistry.

Porras, but was forced to resign on account of ill health.

VERNON, EDWARD, British admiral; born Westminster, Nov. 12, 1684; entered British navy in 1700, and served during war of Spanish Succession, 1701–13; entered Parliament in 1722, retaining his position in the navy; bombarded and took Porto Bello, 1739; repulsed from Cartagena in 1741, and in 1746 was stricken from the list of admirals for publishing pamphlets reflecting on the admiralty; died at Nacton, Suffolk, Eng., Oct. 30, 1751.

W

WALKER, J. A., supt. dept. Operation and Maintenance, The Panama Canal, since April 1, 1914; add., Balboa, Canal Zone.

WALKER, JOHN G., rear adm., U. S. N.; chmn. Nicaragua Canal Comn.; chmn. Isthmian Canal Comn. March 8, 1904–March 31, 1905; born Hillsboro, N. H., March 25, 1835; son of Alden and Susan (Grimes) Walker; married Rebecca White in Sept. 1866; apptd. to U. S. Nav. Acad. from Iowa, 1850; grad. at head of his class in 1856; apptd. lt., 1858; instr. of math. at Annapolis, 1859–60; served in Civil War under Farragut and Porter; 1866 specially promoted to comdr.; ch. Bu. Nav., 1881; made acting rear adml. and given command of the White Squadron, 1889; ch. of Pacific Squadron, and apptd. full rear adml., 1894; retired in 1897; died, 1907.

WALLACE, JOHN FINDLEY, first chief engr., Panama Canal; conducted extensive surveys and examinations and created the initial organization; born Fall River, Mass., Sept. 10, 1852; son of David A. and Martha Findley Wallace; married Sarah E. Ulmer, of Monmouth, Ill.; student Monmouth (Ill.) Col.; C. E. of Wooster, 1882; (LL.D. Monmouth Col., 1904; Sc. D., Armour Inst., Chicago); asst. U. S. engr. on upper Mississippi River and improvements of Rock Island Rapids, 1871–6; co. surveyor and city engr., 1876–8; chief engr. and supt. Peoria & Farmington R. R., 1878–81; Central Ia. Ry. in Ill., 1881–3; constrn. engr. and master of transportation Central Ia. Ry., 1883–6; bridge engr. A. T. & S. F. R. R., 1886–9; res. engr., Chicago, Madison & Northern R. R., 1889–91; with L. C. R. R., 1891–4, as engr. of constrn. 1891–2; chief engr., 1892–7; asst. to 2d v. p., 1897–1900; asst. gen. mgr., 1900–1; gen. mgr., 1901–4; first chief engr. Panama Canal, 1904; Isthmian Canal Comnr. and v.p. and gen. mgr. Panama Railroad and Steamship Co., 1905; designed and constructed World's Fair terminals, Chicago, 1892; also new pass. terminals for C. & N. W. R. R., Chicago; pres. of Electric Properties Co., New York, since 1906; also chmn. Bd. Dirs. Westinghouse, Church, Kerr & Co.; past pres. Am. Soc. C. E., Am. Ry. Engrg. Assn., Western Soc. Engrs.; mem. Instn. Civ. Engrs., Great Britain; clubs—Century, Railroad, Engineers, Sleepy Hollow Country (New York), Metropolitan, Cosmos, (Washington), Chicago, Union League (Chicago); add., 37 Wall st., New York.

WARDLAW, R. H., gen. cashier P. R. R.; born S. C.; went to Isthmus, 1889, as freight agent Panama; apptd. gen. cashier, 1897.

WARREN, H. P., engr. of constrn., Panama Railroad relocation, until 1911.

WARWICK, WALTER W., exam. accts. and aud. Canal Zone, since June, 1908; native of Lucasville, Ohio; ed. pub. sch., Cincinnati; grad. Law Sch. Cin. Col., 1890; practiced in Cincinnati, later went to Washington to enter govt. employ; chief law clk. U. S. Treasury, 1904; apptd. to Wash. Off. Isthmian Canal Comn., 1904, and June 1908, transferred to Isthmus; asso. jus. Supreme Court, Canal Zone, March 1911–May 1911; transferred to Washington as mem. President's Com. on Economy and Efficiency; married Minnie McCormick, 1906.

WATT, JOHN M. G., apptd. asst. office engr., dept. of constrn. and engrg., Canal Zone, Feb. 1, 1909.

WEAVER, JOHN HEISLEY, pres. J. H. Weaver & Co., Phila.; son of George Weaver; ed. pub. schs. and at Dickinson Sem., Williamsport, Pa.; entered service of P. R. R. Co., as messenger boy, and later became clerk; employed by Williamsport Iron & Nail Co., as mgr., and subsequently engaged with Donaldson & Thomas, Phila., as salesman; 1887 embarked in business for himself; one of the pioneers in development of coal areas in Indiana Co., Pa.; mem. Pa. Soc., Union League, Phila.

WEIDMAN, CHARLES E., chief, Fire Dept., Canal Zone; born Illinois; ed. pub. schools; went to Isthmus, 1905; made fire chief, Dec., 1905.

WELLS, GEORGE M., res. engr., dept. Operation and Maintenance, The Panama Canal, since April 1, 1914; office engr. in local chg. municipal engrg., Gatun, June, 1912; add. Culebra, Canal Zone.

WHITE, HENRY, diplomatist; born Baltimore, March 29, 1850; ed. priv. schs., U. S. and France; (LL.D. St. Andrew's, Scot.); married Margaret Stuyvesant Rutherfurd, N. Y., 1879; secy. legation, Vienna, London, 1883–86; secy. embassy, London, 1897–05, frequently chargé d'affaires, participating in negotiation of Hay-Pauncefote treaty; del. to conf. at Algeciras, 1906; ambass. to Italy, 1905–7, to France, 1907–09; del. to Pan-Am. conf., Buenos Aires, spl. ambass. to Chile, 1910; add., 1624 Crescent Pl., N. W., Washington, D. C.

WHITMER, ROBERT FOSTER, pres. William Whitmer & Sons, Inc., Phila., contractors with Panama Canal; born Hartleton, Pa., Jan. 25, 1864; son of William and Catharine A. Whitmer; ed. State Col., and Lafayette (B. A., Lafayette); married Mary Packer at Sunbury, Pa., April, 1891; clubs—University, Union League, Racquet; add., Franklin Bank Bldg., Phila., Pa.

WHITMORE, SAMUEL WASHINGTON, pres. The Whitmore Mfg. Co., Cleveland, O., contractors with Panama Canal; born Llewellyn Park, Orange, N. J.; son of Samuel McCready and Lavinia A. Whitmore; ed. Geneva, N. Y.; married Ethlinda Stuckenholt at Cleveland, O., Aug. 5, 1884; clubs—Cleveland Athletic; add., Erie Railroad and E. 37th st., Cleveland, Ohio.

WIGGINS, P. R., gen. engr., in charge of field work, 3d div., Chagres div., Culebra, 1910–11.

WILLIAMS, EDWARD J., apptd. disbursing officer, Isthmian Canal Comn., Nov. 21, 1905, serving until canal was completed; native of West Salem, Wis.; ed. pub. sch., LaCrosse, Wis., grad., 1889, West Salem High Sch.; grad. Northwestern Univ., 1895; 1897–1905 paym. and traveling auditor C. & N. W. Ry.; married Helen Mary Burton, Dec. 7, 1907.

WILLIAMSON, S. B., div. engr., Pacific div., until Dec. 11, 1912.

WILLSON, F. D., ch. hydrographer, The Panama Canal, since April 1, 1914; apptd. inspr. meteorological and hydrographic work under 3d. div. dept. constrn. and engrg, Canal Zone. 1907; add., Culebra, Canal Zone.

WILSON, EUGENE TRIMBLE, lt. col. Coast Art. Corps, U. S. A., ret., served in charge of subsistence dept., Canal Zone; born May 28, 1867; grad. U. S. Mil. Acad. and add. 2d lt., art. corps., June 11, 1888; 2d lt., Dec. 4, 1888; 1st lt., Feb. 12, 1895; capt., Feb. 2, 1901; maj., Jan. 25, 1907; lt. col. Coast Art. Corps., Dec. 5, 1911; grad. Sch. of Submarine Defence, 1906; Army War Col., 1907; apptd. to charge of subsistence dept., Canal Zone, June 30, 1908; add., R. F. D. 7, London, Ohio.

WILSON, WOODROW, twenty-eighth President of the United States; born Staunton, Va., Dec. 28, 1856; son of Rev. Joseph R. and Jessie (Woodrow) Wilson; ed. Davidson Col., 1874–5; A.B., Princeton, 1879, A.M., 1882; grad. in law, Univ. of Va., 1881; prac. law at Atlanta, Ga., 1882–3; post grad. work at Johns Hopkins, 1883–5; Ph.D., 1886; (LL.D., Wake Forest, 1887; Tulane, 1898; Johns Hopkins, 1902; Rutgers, 1902; Univ. of Pa., 1903; Brown, 1903; Harvard, 1907; Williams, 1908; Dartmouth, 1909; Litt. D., Yale, 1909); married Ellen Louise Axson, of Savannah, Ga., June 24, 1885 (died 1914); pres. 1902–10, Princeton Univ.; gov. of N. J., 1911–13 (resigned); elec. President for term 1913–17.

WOOD, LEONARD, maj. gen., U. S. A.; born Winchester, N. H., Oct. 9, 1860; son of Charles Jewett and Caroline E. (Hagar); grad. Harvard (M.D.) 1884; (LL.D., Harvard, Williams, Univ. of Pa.); married Louisa Condit Smith, Washington, D. C., Nov. 18, 1890; apptd. asst. surg. U. S. A., Jan. 5, 1886; capt., asst. surg., Jan. 5, 1891; colonel 1st U. S. Vol. Cav., 1898; brig. gen., July 8, 1898, for services at Las Guasimas and San Juan Hill; maj. gen., Dec. 7, 1898; hon. disch. from vol. service, 1899; brig. gen., U. S. A., 1899; maj. gen. 1903; awarded Cong. med. honor, 1898, for disting. conduct in campaign agt. Apaches 1886; mil. gov. Cuba, 1899–1902; gov. Moro Prov., P. I., 1903–6; commander Phil. div., 1906–8; com. Dept. of East, 1908–9; spl. ambass. Argentina, 1910; chief of staff, U. S. A., 1910–14, and had supervision of plans for fortification of Panama Canal; com. Dept. of East; add. Governors Island, N. Y.

WOOD, ROBERT E., maj. 3d Cav., U. S. A., ch. qmr., The Panama Canal; born Kansas City, Mo., June 10, 1879; ed. pub. sch.; grad. U. S. Mil. Acad., 1900; 1st lt., Feb. 2, 1909; capt., May 3, 1911; maj., 1915; ordered to Isthmus qmr. dept., 1905; add. Culebra, Canal Zone.

WOOD, WILLIAM M.; born Spring Valley, N. Y.; grad. Agric. and Mech. Col., Texas, as civil engr.; went to Isthmus, 1904, as chief clerk disbursing dept.; apptd. asst. disbursing officer, Aug. 10, 1910.

WRIGHT, DANIEL E., supt. municipal work and pipe lines, The Panama Canal; apptd. asst. engr. Central Div., Canal Zone, Aug. 9, 1909.

WRIGHT, LUKE E., ex-Secretary of War; born in Tenn., 1846; son of Archibald W., chief justice of Tenn.; admitted to Tenn. bar; (LL.D., Hamilton, 1903); married Kate, daughter of Admiral Semmes, C. S. N.; had three sons in service, Span.-Am. War; atty.-gen. Tenn., mem. Philippine Com., 1900–4 (pres. 1903–4); civil gov. P. I., 1904; gov. gen. until 1906; ambassador to Japan, 1906–7; Secretary of War in Roosevelt cabinet, 1908–9, with supervision of Panama Canal; add., Memphis, Tenn.

WYSE, LUCIEN NAPOLEON BONAPARTE, French naval officer; obtained concession from Colombia for Isthmian Canal across Panama, 1878; sold concession in 1879 to de Lesseps.

Z

ZINN, A. S., res. engr. Central Div., The Panama Canal, since Oct. 1906; born Logansport, Ind.; ed. country sch.; grad. Logansport H. S., 1884; three years study Rose Poly. Inst., Terre Haute, Ind.; asst. engr. track elevation, Chicago Belt Ry.; div. engr. and prin. asst. engr. for R. I. Ry. and later engr. of constrn. for Mich. Cent. Ry.; mem. Am. Soc. C. E., Western Soc. Engrs., Am. Eng. and Maintenance of Way Assn.; married June, 1897, to Mabel Gray Cooper at Joliet, Ill.

APPENDIX

APPENDIX

TREATIES BETWEEN THE UNITED STATES AND FOREIGN COUNTRIES RELATING TO INTEROCEANIC COMMUNICATIONS

NEW GRANADA (COLOMBIA)

DECEMBER 12, 1846

TREATY OF PEACE, AMITY, NAVIGATION, AND COMMERCE

This treaty was signed at Bogotá by Benjamin A. Bidlack, United States Chargé d'Affaires, and Manuel Maria Mallarino, Secretary of State and Foreign Relations of New Granada. Ratifications were exchanged June 10, 1848. Articles I to XXXIV inclusive provide for reciprocal trade relations, define the duties of each country in the treatment of vessels and cargoes during war, etc. The essential part of the treaty as affecting the Isthmus of Panama is Article XXXV, reading literally as follows:

The United States of America and the Republic of New Granada desiring to make as durable as possible, the relations which are to be established between the two parties by virtue of this treaty, have declared solemnly, and do agree to the following points:

1. For the better understanding of the preceding articles, it is, and has been stipulated, between the high contracting parties, that the citizens, vessels and merchandise of the United States shall enjoy in the ports of New Granada, including those of the part of the Granadian territory generally denominated *Isthmus of Panamá*, from its southernmost extremity until the boundary of Costa Rica, all the exemptions, privileges and immunities, concerning commerce and navigation, which are now, or may hereafter be enjoyed by Granadian citizens, their vessels and merchandise; and that this equality of favors shall be made to extend to the passengers, correspondence and merchandise of the United States in their transit across the said territory, from one sea to the other. The Government of New Granada guarantees to the Government of the United States, that the right of way or transit across the *Isthmus of Panamá* upon any modes of communication that now exist, or that may be, hereafter, constructed, shall be open and free to the Government and citizens of the United States, and for the transportation of any articles of produce, manufactures or merchandise, of lawful commerce, belonging to the citizens of the United States; that no other tolls or charges shall be levied or collected upon the citizens of the United States, or their said merchandise thus passing over any road or canal that may be made by the Government of New Granada, or by the authority of the same, than is under like circumstances levied upon and collected from the Granadian citizens: that any lawful produce, manufactures or merchandise belonging to citizens of the United States, thus passing from one sea to the other, in either direction, for the purpose of exportation to any other foreign country, shall not be liable to any import duties whatever; or having paid such duties, they shall be entitled to drawback upon their exportation: nor shall the citizens of the United States be liable to any duties, tolls, or charges of any kind to which native citizens are not subjected for thus passing the said Isthmus. And, in order to secure to themselves the tranquil and constant enjoyment of these advantages, and as an especial compensation for the said advantages and for the favours they have acquired by the 4th, 5th and 6th articles of this Treaty, the United States guarantee positively and efficaciously to New Granada, by the present stipulation, the perfect neutrality of the beforementioned Isthmus, with the view that the free transit from the one to the other sea, may not be interrupted or embarrassed in any future time while this Treaty exists; and in consequence, the United States also guarantee, in the same manner, the rights of sovereignty and property which New Granada has and possesses over the said territory.

* * * *

5. If, unfortunately, any of the articles contained in this treaty should be violated or infringed in any way whatever, it is expressly stipulated that neither of the two contracting parties shall ordain or authorize any acts of reprisal, nor shall declare war against the other on complaints of injuries or damages, until the said party considering itself offended shall have laid before the other a statement of such injuries or damages, verified by competent proofs, demanding justice and satisfaction, and the same shall have been denied, in violation of the laws and of international right.

6. Any special or remarkable advantage that one or the other power may enjoy, from the foregoing stipulations, are and ought to be always understood in virtue and as in compensation of the obligations they have just contracted and which have been specified in the first number of this article.

GREAT BRITAIN

April 19, 1850

Clayton-Bulwer Treaty

The United States of America and Her Britannic Majesty, being desirous of consolidating the relations of amity which so happily subsist between them, by setting forth and fixing in a Convention their views and intentions with reference to any means of communication by Ship Canal, which may be constructed between the Atlantic and Pacific Oceans, by the way of the River San Juan de Nicaragua and either or both of the Lakes of Nicaragua or Managua, to any port or place on the Pacific Ocean,—The President of the United States has conferred full powers on John M. Clayton, Secretary of State of the United States; and Her Britannic Majesty on the Right Honourable Sir Henry Lytton Bulwer, a Member of Her Majesty's Most Honourable Privy Council, Knight Commander of the Most Honourable Order of the Bath, and Envoy Extraordinary and Minister Plenipotentiary of Her Britannic Majesty to the United States, for the aforesaid purpose; and the said Plenipotentiaries having exchanged their full powers, which were found to be in proper form, have agreed to the following articles:

Article I.

The Governments of the United States and Great Britain hereby declare, that neither the one nor the other will ever obtain or maintain for itself any exclusive control over the said Ship Canal; agreeing, that neither will ever erect or maintain any fortifications commanding the same, or in the vicinity thereof, or occupy, or fortify, or colonize, or assume, or exercise any dominion over Nicaragua, Costa Rica, the Mosquito coast, or any part of Central America; nor will either make use of any protection which either affords or may afford, or any alliance which either has or may have to or with any state or people, for the purpose of erecting or maintaining any such fortifications, or of occupying, fortifying, or colonizing Nicaragua, Costa Rica, the Mosquito coast, or any part of Central America, or of assuming or exercising dominion over the same; nor will the United States or Great Britain take advantage of any intimacy, or use any alliance, connection, or influence that either may possess with any state or government through whose territory the said canal may pass, for the purpose of acquiring or holding, directly or indirectly, for the citizens or subjects of the one, any rights or advantages in regard to commerce or navigation through the said canal which shall not be offered on the same terms to the citizens or subjects of the other.

Article II.

Vessels of the United States or Great Britain traversing the said canal shall, in case of war between the contracting parties, be exempted from blockade, detention, or capture by either of the belligerents; and this provision shall extend to such a distance from the two ends of the said canal as may hereafter be found expedient to establish.

Article III.

In order to secure the construction of the said canal, the contracting parties engage that if any such canal shall be undertaken upon fair and equitable terms by any parties having the authority of the local government or governments through whose territory the same may pass, then the persons employed in making the said canal, and their property used, or to be used, for that object, shall be protected, from the commencement of the said canal to its completion, by the Governments of the United States and Great Britain, from unjust detention, confiscation, seizure, or any violence whatsoever.

Article IV.

The contracting parties will use whatever influence they respectively exercise with any state, states, or governments possessing or claiming to possess any jurisdiction or right over the territory which the said canal shall traverse, or which shall be near the waters applicable thereto, in order to induce such states or governments to facilitate the construction of the said canal by every means in their power. And, furthermore, the United States and Great Britain agree to use their good offices, wherever or however it may be most expedient, in order to procure the establishment of two free ports, one at each end of the said canal.

Article V.

The contracting parties further engage, that when the said canal shall have been completed, they will protect it from interruption, seizure, or unjust confiscation, and that they will guarantee the neutrality thereof, so that the said canal may forever be open and free, and the capital invested therein secure. Nevertheless, the Governments of the United States and Great Britain, in according their protection to the construction of the said canal, and guaranteeing its neutrality and security when completed, always understand that this protection and guarantee are granted conditionally, and may be withdrawn by both governments, or either government, if both governments, or either government, should deem that the persons or company undertaking or managing the same adopt or establish such regulations concerning the traffic thereupon as are contrary to the spirit and intention of this convention, either by making unfair discrimination in favor of the commerce of one of the contracting parties over the commerce of the other, or by imposing oppressive exactions or unreasonable tolls upon the passengers, vessels, goods, wares, merchandise, or other articles. Neither party, however, shall withdraw the aforesaid protection and guarantee without first giving six months' notice to the other.

Article VI.

The contracting parties in this convention engage to invite every state with which both or either

have friendly intercourse to enter into stipulations with them similar to those which they have entered into with each other, to the end that all other states may share in the honor and advantage of having contributed to a work of such general interest and importance as the canal herein contemplated. And the contracting parties likewise agree that each shall enter into treaty stipulations with such of the Central American states as they may deem advisable, for the purpose of more effectually carrying out the great design of this convention, namely, that of constructing and maintaining the said canal as a ship communication between the two oceans for the benefit of mankind, on equal terms to all, and of protecting the same; and they also agree, that the good offices of either shall be employed, when requested by the other, in aiding and assisting the negotiation of such treaty stipulations; and should any differences arise as to right or property over the territory through which the said canal shall pass between the states or governments of Central America, and such differences should in any way impede or obstruct the execution of the said canal, the Governments of the United States and Great Britain will use their good offices to settle such differences in the manner best suited to promote the interests of the said canal, and to strengthen the bonds of friendship and alliance which exist between the contracting parties.

ARTICLE VII.

It being desirable that no time should be unnecessarily lost in commencing and constructing the said canal, the Governments of the United States and Great Britain determine to give their support and encouragement to such persons or company as may first offer to commence the same, with the necessary capital, the consent of the local authorities, and on such principles as accord with the spirit and intention of this convention; and, if any persons or company should already have, with any state through which the proposed ship canal may pass, a contract for the construction of such canal as that specified in this convention, to the stipulations of which contract neither of the contracting parties in this convention have any just cause to object, and the said persons or company shall moreover have made preparations, and expended time, money, and trouble, on the faith of such contract, it is hereby agreed that such persons or company shall have a priority of claim over every other person, persons, or company to the protection of the Governments of the United States and Great Britain, and be allowed a year from the date of the exchange of the ratifications of this convention for concluding their arrangements, and presenting evidence of sufficient capital subscribed to accomplish the contemplated undertaking; it being understood that if, at the expiration of the aforesaid period, such persons or company be not able to commence and carry out the proposed enterprise, then the Governments of the United States and Great Britain shall be free to afford their protection to any other persons or company that shall be prepared to commence and proceed with the construction of the canal in question.

ARTICLE VIII.

The Governments of the United States and Great Britain having not only desired, in entering into this convention, to accomplish a particular object, but also to establish a general principle, they hereby agree to extend their protection, by treaty stipulations, to any other practicable communications, whether by canal or railway, across the isthmus which connects North and South America, and especially to the interoceanic communications, should the same prove to be practicable, whether by canal or railway, which are now proposed to be established by the way of Tehuantepec or Panama. In granting, however, their joint protection to any such canals or railways as are by this article specified, it is always understood by the United States and Great Britain that the parties constructing or owning the same shall impose no other charges or conditions of traffic thereupon, than the aforesaid governments shall approve of, as just and equitable; and, that the same canals, or railways, being open to the citizens and subjects of the United States and Great Britain on equal terms, shall, also, be open on like terms to the citizens and subjects of every other State which is willing to grant thereto, such protection as the United States and Great Britain engage to afford.

ARTICLE IX.

The ratifications of this Convention shall be exchanged at Washington, within six months from this day, or sooner, if possible.

In faith whereof, we, the respective Plenipotentiaries, have signed this Convention, and have hereunto affixed our seals.

Done, at Washington, the nineteenth day of April, Anno Domini, one thousand eight hundred and fifty.

JOHN M. CLAYTON
HENRY LYTTON BULWER.

GREAT BRITAIN

FEBRUARY 5, 1900

FIRST HAY-PAUNCEFOTE TREATY

This treaty was ratified by the Senate, with amendments, but was rejected by Great Britain.

The first reference to the exemption of American coastwise shipping from canal tolls appears in the discussion of this treaty

by the Senate. Senator Thomas R. Bard, of California, moved to strike out Article III and substitute the following:

"Art. III. The United States reserves the right in the regulation and management of the canal to discriminate in respect of the charges of traffic in favor of vessels of its own citizens engaged in the coastwise trade."

This amendment was rejected by a vote of forty-three to twenty-seven. Senator Bard, referring later to the proposed amendment, said:

"When my amendment was under consideration it was generally conceded by Senators that even without that specific provision the rules of the treaty would not prevent our Government from treating the canal as part of our coast line, and consequently could not be construed as a restriction of our interstate commerce, forbidding the discrimination in charges for tolls in favor of our coastwise trade, and this conviction contributed to the defeat of the amendment."

In the appended copy of the treaty as ratified by the Senate, the Senate amendments are printed in italics, and the portions stricken out by the Senate are printed in brackets.

The United States of America and Her Majesty the Queen of the United Kingdom of Great Britain and Ireland, Empress of India, being desirous to facilitate the construction of a ship canal to connect the Atlantic and Pacific Oceans, and to that end to remove any objection which may arise out of the Convention of April 19, 1850, commonly called the Clayton-Bulwer Treaty, to the construction of such canal under the auspices of the United States, without impairing the "general principle" of neutralization established in Article VIII of that Convention, have for that purpose appointed as their Plenipotentiaries: The President of the United States, John Hay, Secretary of State of the United States of America, and Her Majesty the Queen of Great Britain and Ireland, Empress of India, The Right Honble. Lord Pauncefote, G.C.B., G.C.M.G., Her Majesty's Ambassador Extraordinary and Plenipotentiary to the United States; who, having communicated to each other their full powers, which were found to be in due and proper form, have agreed upon the following articles

ARTICLE I.

It is agreed that the canal may be constructed under the auspices of the Government of the United States, either directly at its own cost or by gift or loan of money to individuals or corporations or through subscription to or purchase of stock or shares, and that, subject to the provisions of the present Convention, the said Government shall have and enjoy all the rights incident to such construction, as well as the exclusive right of providing for the regulation and management of the canal.

ARTICLE II.

The High Contracting Parties, desiring to preserve and maintain the "general principle" of neutralization established in Article VIII of the Clayton-Bulwer Convention, *which Convention is hereby superseded*, adopt, as the basis of such neutralization, the following rules, substantially as embodied in the Convention between Great Britain and certain other Powers, signed at Constantinople October 29, 1888, for the Free Navigation of the Suez Maritime Canal, that is to say:

1. The canal shall be free and open, in time of war as in time of peace, to the vessels of commerce and of war of all nations, on terms of entire equality, so that there shall be no discrimination against any nation or its citizens or subjects in respect of the conditions or charges of traffic, or otherwise.

2. The canal shall never be blockaded, nor shall any right of war be exercised nor any act of hostility be committed within it.

3. Vessels of war of a belligerent shall not revictual nor take any stores in the canal except so far as may be strictly necessary; and the transit of such vessels through the canal shall be effected with the least possible delay, in accordance with the regulations in force, and with only such intermission as may result from the necessities of the service.

Prizes shall be in all respects subject to the same rules as vessels of war of the belligerents.

4. No belligerent shall embark or disembark troops, munitions of war or warlike materials in the canal except in case of accidental hindrance of the transit, and in such case the transit shall be resumed with all possible despatch.

5. The provisions of this article shall apply to waters adjacent to the canal, within three marine miles of either end. Vessels of war of a belligerent shall not remain in such waters longer than twenty-four hours at any one time except in case of distress, and in such case shall depart as soon as possible; but a vessel of war of one belligerent shall not depart within twenty-four hours from the departure of a vessel of war of the other belligerent.

It is agreed, however, that none of the immediate foregoing conditions and stipulations in sections numbered one, two, three, four, and five of this article shall apply to measures which the United States may find it necessary to take for securing by its own forces the defense of the United States and the maintenance of public order.

6. The plant, establishments, buildings, and all works necessary to the construction, maintenance and operation of the canal shall be deemed to be part thereof, for the purposes of this convention, and in time of war as in time of peace shall enjoy complete immunity from attack or injury by belligerents and from acts calculated to impair their usefulness as part of the canal.

7. No fortifications shall be erected commanding the canal or the waters adjacent. The United States, however, shall be at liberty to maintain such military police along the canal as may be necessary to protect it against lawlessness and disorder.

[ARTICLE III.]

[The High Contracting Parties will, immediately upon the exchange of the ratifications of this Convention, bring it to the notice of the other Powers and invite them to adhere to it.]

ARTICLE IV.

The present Convention shall be ratified by the President of the United States, by and with the advice and consent of the Senate thereof, and by Her Britannic Majesty; and the ratifications shall be exchanged at Washington or at London within six months from the date hereof, or earlier if possible.

In faith whereof the respective Plenipotentiaries have signed this Convention and thereunto affixed their seals.

Done in duplicate at Washington the fifth day of February in the year of Our Lord one thousand nine hundred.

JOHN HAY.
PAUNCEFOTE.

GREAT BRITAIN

NOVEMBER 18, 1901

HAY-PAUNCEFOTE TREATY

Ratifications of this treaty were exchanged on Feb. 21, 1902, and it was proclaimed on Feb. 22, 1902.

The United States of America and His Majesty Edward the Seventh, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, and Emperor of India being desirous to facilitate the construction of a ship canal to connect the Atlantic and Pacific Oceans, by whatever route may be considered expedient, and to that end to remove any objection which may arise out of the Convention of the 19th April, 1850, commonly called the Clayton-Bulwer Treaty, to the construction of such canal under the auspices of the Government of the United States, without impairing the "general principle" of neutralization established in Article VIII of that Convention, have for that purpose appointed as their Plenipotentiaries: The President of the United States, John Hay, Secretary of State of the United States of America; and His Majesty Edward the Seventh, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, and Emperor of India, the Right Honourable Lord Pauncefote, G.C.B., G.C.M.G., His Majesty's Ambassador Extraordinary and Plenipotentiary to the United States; who, having communicated to each other their full powers which were found to be in due and proper form, have agreed upon the following Articles:

ARTICLE I.

The High Contracting Parties agree that the present Treaty shall supersede the afore-mentioned Convention of the 19th April, 1850.

ARTICLE II.

It is agreed that the canal may be constructed under the auspices of the Government of the United States, either directly at its own cost, or by gift or loan of money to individuals or corporations, or through subscription to or purchase of stock or shares, and that, subject to the provisions of the present Treaty, the said Government shall have and enjoy all the rights incident to such construction, as well as the exclusive right of providing for the regulation and management of the canal.

ARTICLE III.

The United States adopts, as the basis of the neutralization of such ship canal, the following Rules, substantially as embodied in the Convention of Constantinople, signed the 28th October, 1888, for the free navigation of the Suez Canal, that is to say:

1. The canal shall be free and open to the vessels of commerce and of war of all nations observing these Rules, on terms of entire equality, so that there shall be no discrimination against any such nation, or its citizens or subjects, in respect of the conditions or charges of traffic, or otherwise. Such conditions and charges of traffic shall be just and equitable.

2. The canal shall never be blockaded, nor shall any right of war be exercised nor any act of hostility be committed within it. The United States, however, shall be at liberty to maintain such military police along the canal as may be necessary to protect it against lawlessness and disorder.

3. Vessels of war of a belligerent shall not revictual nor take any stores in the canal except so far as may be strictly necessary; and the transit of such vessels through the canal shall be effected with the least possible delay in accordance with the Regulations in force, with and only such intermission as may result from the necessities of the service.

Prizes shall be in all respects subject to the same Rules as vessels of war of the belligerents.

4. No belligerent shall embark or disembark troops, munitions of war, or warlike materials in the canal, except in case of accidental hindrance of the transit, and in such case the transit shall be resumed with all possible dispatch.

5. The provisions of this Article shall apply to waters adjacent to the canal, within 3 marine miles of either end. Vessels of war of a belligerent shall not remain in such waters longer than twenty-four hours at any one time, except in case of distress, and in such case shall depart as soon as possible; but a vessel of war of one belligerent shall not depart within twenty-four hours from the departure of a vessel of war of the other belligerent.

6. The plant, establishments, buildings, and all works necessary to the construction, maintenance, and operation of the canal shall be deemed to be part thereof, for the purposes of this Treaty, and

in time of war, as in time of peace, shall enjoy complete immunity from attack or injury by belligerents, and from acts calculated to impair their usefulness as part of the canal.

ARTICLE IV.

It is agreed that no change of territorial sovereignty or of the international relations of the country or countries traversed by the before-mentioned canal shall affect the general principle of neutralization or the obligation of the High Contracting Parties under the present Treaty.

ARTICLE V.

The present Treaty shall be ratified by the President of the United States, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty; and the ratifications shall be exchanged at Washington or at London at the earliest possible time within six months from the date hereof.

In faith whereof the respective Plenipotentiaries have signed this Treaty and thereunto affixed their seals.

Done in duplicate at Washington, the 18th day of November, in the year of Our Lord one thousand nine hundred and one.

JOHN HAY.
PAUNCEFOTE.

HAY-CONCHA AGREEMENT

MEMORANDUM OF POINTS TO BE EMBODIED IN A TREATY BETWEEN COLOMBIA AND THE UNITED STATES

Early in 1902, after the House of Representatives had passed the bill providing for a Nicaragua canal, and the canal commission had reported in favor of accepting the offer of the New Panama Canal Company to sell its properties for $40,000,000, assurance was demanded that Colombia would consent to the transfer of the French company's concession and grant to the United States the right of way for a canal. Mr. José Vicente Concha, formerly Colombian Secretary of War, was sent to the United States as minister to negotiate a treaty which would bring about the construction of the canal at Panama. After repeated conferences with William Nelson Cromwell, general counsel in America for the New Panama Canal Company, Mr. Concha submitted a draft of a treaty to Secretary Hay, in the following letter:

LEGACION DE COLOMBIA,
Washington, D. C., March 31, 1902.

HON. JOHN HAY,
Secretary of State of the United States:

I have the honor to hand to your excellency the proposal of the Republic of Colombia for a concessionary convention or treaty between the Republic of Colombia and the United States of America, respecting the completion, maintenance, operation, control, and protection of the interoceanic canal over the Isthmus of Panama

I soon shall hand you a letter of exposition, and also have requested Mr. William Nelson Cromwell, general counsel of the New Panama Canal Company, to present you a statement which I have approved.

Please accept these additional communications in connection with the proposed treaty.

I avail myself of this opportunity to renew to your excellency the assurance of my high consideration.

JOSÉ VICENTE CONCHA.

Mr. Concha's letter of exposition and Mr. Cromwell's letter were sent to Secretary Hay on the same date, March 31, and on April 18, after a conference between Mr. Hay and Mr. Cromwell, certain changes were made in the proposed treaty and agreed upon by both sides. The revised draft was then sent to Secretary Hay by Mr. Concha with the assurance that he was ready to sign the treaty in behalf of Colombia.

The draft of the treaty is summarized as follows:

Columbia authorizes the New Panama Canal Company to sell its concessions and properties, including the Panama Railroad, to the United States.

The United States is given the exclusive right to construct the Panama Canal across the territory of Colombia, and for that purpose Colombia grants the use of a zone ten kilometers in width, exclusive of the cities of Panama and Colon, for a term of 100 years, renewable for like periods at the option of the United States. The stipulations of Article 35 of the treaty of 1846 between the United States and New Granada shall continue and apply in full force.

The rights granted to the United States shall not affect the sovereignty of Colombia. The United States recognizes this sovereignty.

Colombia authorizes the United States to construct a port at each terminus of the canal. The United States will take charge of sanitary questions and provide hospitals, water systems, etc.

Colombia agrees that it will not cede or lease to any other foreign government any islands or harbors adjacent to Panama.

Colombia grants the free use of the Chagres River and other waterways, declares the ports free, exempts vessels of the United States from taxation, exempts the canal and railroad from taxation, and authorizes the construction of telegraph and telephone lines; grants free immigration of canal laborers, and the free importation of canal machinery and equipment of all kinds; authorizes the expropriation of necessary lands; grants the free use of ports for places of refuge; and authorizes the United States to establish and enforce regulations regarding the preservation of order and the operation of the canal.

It is agreed that the canal shall be neutral in perpetuity, and shall be opened upon equal terms to the vessels of all nations at uniform tonnage and other rates, in conformity with the Hay-Pauncefote treaty.

Colombia agrees to cancel or modify any treaties with other nations which may be incompatible with the present convention. It also renounces participation in the future earnings of the canal under the concessions to the French company. It agrees to provide armed forces for the protection of the canal, and to permit the United States to use its forces if necessary.

The United States agrees to begin construction within two years and complete the canal in twelve years; and in case of unforeseen obstacles Colombia agrees that the term of completion may be prolonged for twelve years more.

In consideration of the right to use the Canal zone, and the proprietary right over the Panama Railroad, and for the annuity of $250,000 which Colombia ceases to receive from the railroad, the United States agrees to pay Colombia $7,000,000 in gold, and an annuity, to begin fourteen years after ratification of the treaty, the amount of the annuity to be agreed upon. In case they cannot agree, each shall appoint two commissioners, and the president of the International Peace Tribunal at The Hague shall constitute the fifth; and the determination of said commission shall be binding as to the amount of the annuity.

If after five years from the date of the treaty the work shall not have been commenced, or if after the expiration of twelve years and the extension of twelve years thereafter the canal shall not have been completed, all the concessions granted and the machinery and works shall be forfeited to Colombia, together with any money paid.

The treaty shall be ratified within eight months from this date.

This draft of the treaty summarized above was accepted by the United States in the following letter:

DEPARTMENT OF STATE,
Washington, April 21, 1902

SIR:—I have the honor to acknowledge receipt at your hands of a communication dated the 31st of March, 1902, and another of the 18th of April, inclosing a proposal of the Republic of Colombia for a concessionary convention or treaty between the Republic of Colombia and the United States of America respecting the completion, maintenance, operation, control, and protection of an interoceanic canal over the Isthmus of Panama.

I am directed by the President to inform you that I shall be ready to sign with you the proposed convention as soon as—

First. The Congress of the United States shall have authorized the President to enter into such an arrangement; and

Second. As soon as the law officers of this Government shall have decided upon the question of the title which the New Panama Canal Company is able to give of all the properties and rights claimed by it and pertaining to a canal across the Isthmus and covered by the pending proposal.

Accept, sir, the renewed assurance of my highest consideration.

JOHN HAY.

Señor Don JOSÉ VICENTE CONCHA.

Minister Concha replied, under date of April 23, 1902, acknowledging receipt of the notification that the United States was ready under certain contingencies to sign the treaty. He added: "When the occasion to sign the above-mentioned treaty shall arise I will present, according to usage, the full powers authorizing me to do so."

It was upon this agreement between Secretary Hay and Minister Concha that the United States proceeded to enter into the Hay-Herran treaty, and the United States insisted that Colombia should ratify the treaty in compliance with its promise made through Mr. Concha.

COLOMBIA

JANUARY 22, 1903

HAY-HERRAN TREATY

This treaty was ratified by the United States Senate March 17, 1903, but was rejected by the Senate of Colombia. Following the rejection of the treaty occurred the revolution at Panama and the creation of the Panama Republic.

The United States of America and the Republic of Colombia, being desirous to assure the construction of a ship canal to connect the Atlantic and Pacific Oceans and the Congress of the United States of America having passed an Act approved June 28, 1902, in furtherance of that object, a copy of which is hereunto annexed, the High Contracting Parties have resolved, for that purpose, to conclude a Convention and have accordingly appointed as their Plenipotentiaries: The President of the United States of America, John Hay, Secretary of State, and the President of the Republic of Colombia, Thomas Herran, Chargé d'Affaires, thereunto specially empowered by said government who, after communicating to each other their respective full powers, found in good and due form, have agreed upon and concluded the following Articles:

ARTICLE I.

The Government of Colombia authorizes the New Panama Canal Company to sell and transfer to the United States its rights, privileges, properties, and concessions, as well as the Panama Railroad and all the shares or part of the shares of that company; but the public lands situated outside of the zone hereinafter specified, now corresponding to the concessions to both said enterprises shall revert to the Republic of Colombia, except any property now owned by or in the possession of the said companies within Panama or Colon, or the ports and terminals thereof.

But it is understood that Colombia reserves all its rights to the special shares in the capital of the New Panama Canal Company to which reference is made in Article IV of the contract of December 10, 1890, which shares shall be paid their full nominal value at least; but as such right of Colombia exists solely in its character of stockholder in said Company, no obligation under this provision is imposed upon or assumed by the United States.

The Railroad Company (and the United States as owner of the enterprise) shall be free from the obligations imposed by the railroad concession, excepting as to the payment at maturity by the Railroad Company of the outstanding bonds issued by said Railroad Company.

ARTICLE II.

The United States shall have the exclusive right for the term of one hundred years, renewable at the sole and absolute option of the United States, for periods of similar duration so long as the United States may desire, to excavate, construct, maintain, operate, control, and protect the Maritime Canal with or without locks from the Atlantic to the Pacific Ocean, to and across the territory of Colombia, such canal to be of sufficient depth and capacity for vessels of the largest tonnage and greatest draft now engaged in commerce, and such as may be reasonably anticipated, and also the same rights for the construction, maintenance, operation, control, and protection of the Panama Railroad and of railway, telegraph and telephone lines, canals, dikes, dams, and reservoirs, and such other auxiliary works as may be necessary and convenient for the construction, maintenance, protection, and operation of the canal and railroads.

ARTICLE III.

To enable the United States to exercise the rights and privileges granted by this Treaty the Republic of Colombia grants to that Government the use and control for the term of one hundred years, renewable at the sole and absolute option of the United States, for periods of similar duration so long as the United States may desire, of a zone of territory along the route of the canal to be constructed five kilometers in width on either side thereof measured from its center line including therein the necessary auxiliary canals not exceeding in any case fifteen miles from the main canal and other works, together with ten fathoms of water in the Bay of Limon in extension of the canal, and at least three marine miles from mean low water mark from each terminus of the canal into the Caribbean Sea and the Pacific Ocean respectively. So far as necessary for the construction, maintenance and operation of the canal, the United States shall have the use and occupation of the group of small islands in the Bay of Panama named Perico, Naos, Culebra and Flamenco, but the same shall not be construed as being within the zone herein defined nor governed by the special provisions applicable to the same.

This grant shall in no manner invalidate the titles or rights of private land owners in the said zone of territory, nor shall it interfere with the rights of way over the public roads of the Department; provided, however, that nothing herein contained shall operate to diminish, impair or restrict the rights elsewhere herein granted to the United States.

This grant shall not include the cities of Panama and Colon, except so far as lands and other property therein are now owned by or in possession of the said Canal Company or the said Railroad Company; but all the stipulations contained in Article 35 of the Treaty of 1846–48 between the contracting parties shall continue and apply in full force to the cities of Panama and Colon and to the accessory community lands and other property within the said zone, and the territory thereon shall be neutral territory, and the United States shall continue to guarantee the neutrality thereof and the sovereignty of Colombia thereover, in conformity with the above-mentioned Article 35 of said Treaty.

In furtherance of this last provision there shall be created a Joint Commission by the Governments of Colombia and the United States that shall establish and enforce sanitary and police regulations.

ARTICLE IV.

The rights and privileges granted to the United States by the terms of this Convention shall not affect the sovereignty of the Republic of Colombia over the territory within whose boundaries such rights and privileges are to be exercised.

The United States freely acknowledges and recognizes this sovereignty and disavows any intention to impair it in any way whatever or to increase its territory at the expense of Colombia or of any of the sister republics in Central or South America, but on the contrary, it desires to strengthen the power of the republics on this continent, and to promote, develop and maintain their prosperity and independence.

ARTICLE V.

The Republic of Colombia authorizes the United States to construct and maintain at each entrance and terminus of the proposed canal a port for vessels using the same, with suitable light houses and other aids to navigation, and the United States is authorized to use and occupy within the limits of the zone fixed by this convention, such parts of the coast line and of the lands and islands adjacent thereto as are necessary for this purpose, including the construction and maintenance of breakwaters, dikes, jetties, embankments, coaling stations, docks and other appropriate works, and the United States undertakes the construction and maintenance of such works and will bear all expense thereof. The ports when established are declared free, and their demarcations shall be clearly and definitely defined.

To give effect to this Article, the United States will give special attention and care to the maintenance of works for drainage, sanitary and healthful purposes along the line of the canal, and its dependencies, in order to prevent the invasion of epidemics or of securing their prompt suppression should they appear. With this end in view the United States will organize hospitals along the line of the canal, and will suitably supply or cause to be supplied the towns of Panama and Colon with the necessary aqueducts and drainage works, in order to prevent their becoming centers of infection on account of their proximity to the canal.

The Government of Colombia will secure for the United States or its nominees the lands and rights that may be required in the towns of Panama and Colon to effect the improvements above referred to, and the Government of the United States or its nominees shall be authorized to impose and collect equitable water rates, during fifty years for the service rendered; but on the expiration of said term the use of the water shall be free for the inhabitants of Panama and Colon, except to the extent that may be necessary for the operation and maintenance of said water system, including reservoirs, aqueducts, hydrants, supply service, drainage and other works.

ARTICLE VI.

The Republic of Colombia agrees that it will not cede or lease to any foreign Government any of its islands or harbors within or adjacent to the Bay of Panama, nor on the Atlantic Coast of Colombia, between the Atrato River and the western boundary of the Department of Panama, for the purpose of establishing fortifications, naval or coaling stations, military posts, docks or other works that might interfere with the construction, maintenance, operation, protection, safety, and free use of the canal and auxiliary works. In order to enable Colombia to comply with this stipulation, the Government of the United States agrees to give Colombia the material support that may be required in order to prevent the occupation of said islands and ports, guaranteeing there the sovereignty, independence and integrity of Colombia.

ARTICLE VII.

The Republic of Colombia includes in the foregoing grant the right without obstacle, cost, or impediment, to such control, consumption and general utilization in any manner found necessary by the United States to the exercise by it of the grants to, and rights conferred upon it by this Treaty, the waters of the Chagres River and other streams, lakes and lagoons, of all non-navigable waters, natural and artificial, and also to navigate all rivers, streams, lakes and other navigable waterways, within the jurisdiction and under the dominion of the Republic of Colombia, in the Department of Panama, within or without said zone, as may be necessary or desirable for the construction, maintenance and operation of the canal and its auxiliary canals and other works, and without tolls or charges of any kind; and to raise and lower the levels of the waters, and to deflect them, and to impound any such waters and to overflow any lands necessary for the due exercise of such grants and rights to the United States; and to rectify, construct and improve the navigation of any such rivers, streams, lakes and lagoons at the sole cost of the United States; but any such water ways so made by the United States may be used by citizens of Colombia free of tolls or other charges. And the United States shall have the right to use without cost, any water, stone, clay, earth or other minerals belonging to Colombia on the public domain that may be needed by it.

All damages caused to private land owners by inundation or by the deviation of water courses, or in other ways, arising out of the construction or operation of the canal, shall in each case be appraised and settled by a joint commission appointed by the Governments of the United States and Colombia, but the cost of the indemnities so agreed upon shall be borne solely by the United States.

ARTICLE VIII.

The Government of Colombia declares free for all time the ports at either entrance of the Canal, including Panama and Colon and the waters thereof in such manner that there shall not be collected by the Government of Colombia custom house tolls, tonnage, anchorage, light-house, wharf, pilot, or quarantine dues, nor any other charges or taxes of any kind shall be levied or imposed by the Government of Colombia upon any vessel using or passing through the canal or belonging to or employed by the United States, directly or indirectly, in connection with the construction, maintenance and operation of the main work or its auxiliaries, or upon the cargo, officers, crew, or passengers of any such vessels; it being the intent of this Convention that all vessels and their cargoes, crews, and passengers, shall be permitted to use and pass through the canal and the ports leading thereto, subject to no other demands or impositions than such tolls and charges as may be imposed by the United States for the use of the canal and other works. It being understood that such tolls and charges shall be governed by the provisions of Article XVI.

The ports leading to the canal, including Panama and Colon, also shall be free to the commerce of the world, and no duties or taxes shall be imposed, except upon merchandise destined to be introduced for the consumption of the rest of the Re-

public of Colombia, or the Department of Panama, and upon vessels touching at the ports of Colon and Panama and which do not cross the Canal.

Though the said ports shall be free and open to all, the Government of Colombia may establish in them such custom houses and guards as Colombia may deem necessary to collect duties on importations destined to other portions of Colombia and to prevent contraband trade. The United States shall have the right to make use of the ports at the two extremities of the canal including Panama and Colon as places of anchorage, in order to make repairs for loading, unloading, depositing, or transshipping cargoes either in transit or destined for the service of the canal and other works.

Any concessions or privileges granted by Colombia for the operation of light houses at Colon and Panama shall be subject to expropriation, indemnification and payment in the same manner as is provided by Article XIV in respect to the property therein mentioned; but Colombia shall make no additional grant of any such privilege nor change the status of any existing concession.

ARTICLE IX.

There shall not be imposed any taxes, national, municipal, departmental, or of any other class, upon the canal, the vessels that may use it, tugs and other vessels employed in the service of the canal, the railways and auxiliary works, store houses, work shops, offices, quarters for laborers, factories of all kinds, warehouses, wharves, machinery and other works, property, and effects appertaining to the canal or railroad or that may be necessary for the service of the canal or railroad and their dependencies, whether situated within the cities of Panama and Colon, or any other place authorized by the provisions of this Convention.

Nor shall there be imposed contributions or charges of a personal character of whatever species upon officers, employees, laborers, and other individuals in the service of the canal and its dependencies.

ARTICLE X.

It is agreed that telegraph and telephone lines, when established for canal purposes, may also, under suitable regulations, be used for public and private business in connection with the systems of Colombia and the other American Republics and with the lines of cable companies authorized to enter the ports and territories of these Republics; but the official dispatches of the Government of Colombia and the authorities of the Department of Panama shall not pay for such service higher tolls than those required from the officials in the service of the United States.

ARTICLE XI.

The Government of Colombia shall permit the immigration and free access to the lands and work shops of the canal and its dependencies of all employees and workmen of whatever nationality under contract to work upon or seeking employment or in any wise connected with the said canal and its dependencies, with their respective families, and all such persons shall be free and exempt from the military service of the Republic of Colombia.

ARTICLE XII.

The United States may import at any time into the said zone, free customs duties, imposts, taxes, or other charges, and without any restriction, any and all vessels, dredges, engines, cars, machinery, tools, explosives, materials, supplies, and other articles necessary and convenient in the construction, maintenance and operation of the canal and auxiliary works, also all provisions, medicines, clothing, supplies and other things necessary and convenient for the officers, employees, workmen and laborers in the service and employ of the United States and for their families. If any such articles are disposed of for use without the zone excepting Panama and Colon and within the territory of the Republic, they shall be subject to the same import or other duties as like articles under the laws of Colombia or the ordinances of the Department of Panama.

ARTICLE XIII.

The United States shall have authority to protect and make secure the canal, as well as railways and other auxiliary works and dependencies, and to preserve order and discipline among the laborers and other persons who may congregate in that region and to make and enforce such police and sanitary regulations as it may deem necessary to preserve order and public health thereon, and to protect navigation and commerce through and over said canal, railways and other works and dependencies from interruption or damage.

I. The Republic of Colombia may establish judicial tribunals within said zone, for the determination, according to its laws and judicial procedure, of certain controversies hereinafter mentioned.

Such judicial tribunal or tribunals so established by the Republic of Colombia shall have exclusive jurisdiction in said zone of all controversies between citizens of the Republic of Colombia, or between citizens of the Republic of Colombia and citizens of any foreign nation other than the United States.

II. Subject to the general sovereignty of Colombia over said zone, the United States may establish judicial tribunals thereon, which shall have jurisdiction of certain controversies hereinafter mentioned to be determined according to the laws and judicial procedure of the United States.

Such judicial tribunal or tribunals so established by the United States shall have exclusive jurisdiction in said zone of all controversies between citizens of the United States, and between citizens of the United States and citizens of any foreign nation other than the Republic of Colombia; and of all controversies in any wise growing out of or relating to the construction, maintenance or operation of the canal, railway and other properties and works.

III. The United States and Colombia engage jointly to establish and maintain upon said zone, judicial tribunals having civil, criminal and admiralty jurisdiction and to be composed of jurists appointed by the Governments of the United States and Colombia in a manner hereafter to be agreed upon between said Governments, and which tribunals shall have jurisdiction of certain controversies hereinafter mentioned, and of all crimes, felonies and misdemeanors committed within said zone,

and of all cases arising in admiralty, according to such laws and procedure as shall be hereafter agreed upon and declared by the two governments.

Such joint judicial tribunal shall have exclusive jurisdiction in said zone of all controversies between citizens of the United States and citizens of Colombia, and between citizens of nations other than Colombia or the United States; and also of all crimes, felonies and misdemeanors committed within said zone, and of all questions of admiralty arising therein.

IV. The two Governments hereafter, and from time to time as occasion arises, shall agree upon and establish the laws and procedures which shall govern such joint judicial tribunal and which shall be applicable to the persons and cases over which such tribunal shall have jurisdiction, and also shall likewise create the requisite officers and employees of such court and establish their powers and duties; and further shall make adequate provision by like agreement for the pursuit, capture, imprisonment, detention, and delivery within said zone of persons charged with the commitment of crimes, felonies or misdemeanors without said zone; and for the pursuit, capture, imprisonment, detention and delivery without said zone of persons charged with the commitment of crimes, felonies and misdemeanors within said zone.

ARTICLE XIV.

The works of the canal, the railways and their auxiliaries are declared of public utility, and in consequence all areas of land and water necessary for the construction, maintenance, and operation of the canal and the other specified works may be expropriated in conformity with the laws of Colombia, except that the indemnity shall be conclusively determined without appeal, by a joint commission appointed by the Governments of Colombia and the United States.

The indemnities awarded by the Commission for such expropriation shall be borne by the United States, but the appraisal of said lands and the assessment of damages shall be based upon their value before the commencement of the work upon the canal.

ARTICLE XV.

The Republic of Colombia grants to the United States the use of all the ports of the Republic open to commerce as places of refuge for any vessels employed in the canal enterprise, and for all vessels in distress having the right to pass through the canal and wishing to anchor in said ports. Such vessels shall be exempt from anchorage and tonnage dues on the part of Colombia.

ARTICLE XVI.

The canal, when constructed, and the entrance thereto shall be neutral in perpetuity, and shall be opened upon the terms provided for by Section I of Article three of, and in conformity with all the stipulations of, the treaty entered into by the Governments of the United States and Great Britain on November 18, 1901.

ARTICLE XVII.

The Government of Colombia shall have the right to transport over the canal its vessels, troops, and munitions of war at all times without paying charges of any kind. This exemption is to be extended to the auxiliary railway for the transportation of persons in the service of the Republic of Colombia or of the Department of Panama, or of the police force charged with the preservation of public order outside of said zone, as well as to their baggage, munitions of war and supplies.

ARTICLE XVIII.

The United States shall have full power and authority to establish and enforce regulations for the use of the canal, railways, and the entering ports and auxiliary works, and to fix rates of tolls and charges thereof, subject to the limitations stated in Article XVI.

ARTICLE XIX.

The rights and privileges granted to the United States by this convention shall not affect the sovereignty of the Republic of Colombia over the real estate that may be acquired by the United States by reason of the transfer of the rights of the New Panama Canal Company and the Panama Railroad Company lying outside of the said canal zone.

ARTICLE XX.

If by virtue of any existing treaty between the Republic of Colombia and any third power, there may be any privilege or concession relative to an interoceanic means of communication which especially favors such third power, and which in any of its terms may be incompatible with the terms of the present convention, the Republic of Colombia agrees to cancel or modify such treaty in due form, for which purpose it shall give to the said third power the requisite notification within the term of four months from the date of the present convention, and in case the existing treaty contains no clause permitting its modification or annulment, the Republic of Colombia agrees to procure its modification or annulment in such form that there shall not exist any conflict with the stipulations of the present convention.

ARTICLE XXI.

The rights and privileges granted by the Republic of Colombia to the United States in the preceding Articles are understood to be free of all anterior concessions or privileges to other Governments, corporations, syndicates or individuals, and consequently, if there should arise any claims on account of the present concessions and privileges or otherwise the claimants shall resort to the Government of Colombia and not to the United States for any indemnity or compromise which may be required.

ARTICLE XXII.

The Republic of Colombia renounces and grants to the United States the participation to which it might be entitled in the future earnings of the canal under Article XV of the concessionary contract with Lucien N. B. Wyse now owned by the New

Panama Canal Company and any and all other rights or claims of a pecuniary nature arising under or relating to said concession, or arising under or relating to the concessions to the Panama Railroad Company or any extension or modification thereof; and it likewise renounces, confirms and grants to the United States, now and hereafter, all the rights and property reserved in the said concessions which otherwise would belong to Colombia at or before the expiration of the terms of ninety-nine years of the concessions granted to or held by the above mentioned party and companies, and all right, title and interest which it now has or may hereafter have, in and to the lands, canal, works, property and rights held by the said companies under said concessions or otherwise, and acquired or to be acquired by the United States from or through the New Panama Canal Company, including any property and rights which might or may in the future either by lapse of time, forfeiture or otherwise, revert to the Republic of Colombia under any contracts of concessions, with said Wyse, the Universal Panama Canal Company, the Panama Railroad Company and the New Panama Canal Company.

The aforesaid rights and property shall be and are free and released from any present or reversionary interest in or claims of Colombia and the title of the United States thereto upon consummation of the contemplated purchase by the United States from the New Panama Canal Company, shall be absolute, so far as concerns the Republic of Colombia, excepting always the rights of Colombia specifically secured under this treaty.

ARTICLE XXIII.

If it should become necessary at any time to employ armed forces for the safety or protection of the canal, or of the ships that make use of the same, or the railways and other works, the Republic of Colombia agrees to provide the forces necessary for such purpose, according to the circumstances of the case, but if the Government of Colombia cannot effectively comply with this obligation, then, with the consent of or at the request of Colombia, or of her Minister at Washington, or of the local authorities, civil or military, the United States shall employ such force as may be necessary for that sole purpose; and as soon as the necessity shall have ceased will withdraw the forces so employed. Under exceptional circumstances, however, on account of unforeseen or imminent danger to said canal, railways and other works, or to the lives and property of the persons employed upon the canal, railways, and other works, the Government of the United States is authorized to act in the interest of their protection, without the necessity of obtaining the consent beforehand of the Government of Colombia; and it shall give immediate advice of the measures adopted for the purpose stated; and as soon as sufficient Colombian forces shall arrive to attend to the indicated purpose, those of the United States shall retire.

ARTICLE XXIV.

The Government of the United States agrees to complete the construction of the preliminary works necessary, together with all the auxiliary works, in the shortest time possible; and within two years from the date of the exchange of ratification of this convention the main works of the canal proper shall be commenced, and it shall be opened to the traffic between the two oceans within twelve years after such period of two years. In case, however, that any difficulties or obstacles should arise in the construction of the canal which are at present impossible to foresee, in consideration of the good faith with which the Government of the United States shall have proceeded, and the large amount of money expended so far on the works and the nature of the difficulties which may have arisen, the Government of Colombia will prolong the terms stipulated in this Article up to twelve years more for the completion of the work of the canal.

But in case the United States should, at any time, determine to make such canal practically a sea level canal, then such period shall be extended for ten years further.

ARTICLE XXV.

As the price or compensation for the right to use the zone granted in this convention by Colombia to the United States for the construction of a canal, together with the proprietary right over the Panama Railroad, and for the annuity of two hundred and fifty thousand dollars gold, which Colombia ceases to receive from the said railroad, as well as in compensation for other rights, privileges and exemptions granted to the United States, and in consideration of the increase in the administrative expenses of the Department of Panama consequent upon the construction of the said canal, the Government of the United States binds itself to pay Colombia the sum of ten million dollars in gold coin of the United States on the exchange of the ratification of this convention after its approval according to the laws of the respective countries, and also an annual payment during the life of this convention of two hundred and fifty thousand dollars in like gold coin, beginning nine years after the date aforesaid.

The provisions of this Article shall be in addition to all other benefits assured to Colombia under this convention.

But no delay nor difference of opinion under this Article shall affect nor interrupt the full operation and effect of this convention in all other respects:

ARTICLE XXVI.

No change either in the Government or in the laws and treaties of Colombia, shall, without the consent of the United States, affect any right of the United States under the present convention, or under any treaty stipulation between the two countries (that now exist or may hereafter exist) touching the subject-matter of this convention.

If Colombia shall hereafter enter as a constituent into any other Government or into any union or confederation of States so as to merge her sovereignty or independence in such Government, union, or confederation, the rights of the United States under this convention shall not be in any respect lessened or impaired.

ARTICLE XXVII.

The joint commission referred to in Articles III, VII and XIV shall be established as follows:

The President of the United States shall nominate two persons and the President of Colombia shall nominate two persons and they shall proceed to a decision; but in case of disagreement of the Commission (by reason of their being equally divided in conclusion) an umpire shall be appointed by the two Governments, who shall render the decision. In the event of death, absence or incapacity of any Commissioner or umpire, or of his omitting, declining or ceasing to act, his place shall be filled by the appointment of another person in the manner above indicated. All decisions by a majority of the Commission or by the umpire shall be final.

ARTICLE XXVIII.

This convention when signed by the contracting parties, shall be ratified according to the laws of the respective countries and shall be exchanged at Washington within a term of eight months from this date or earlier if possible.

In faith whereof, the respective plenipotentiaries have signed the present convention in duplicate and have hereunto affixed their respective seals.

Done at the City of Washington, the 22d day of January in the year of our Lord nineteen hundred and three.

JOHN HAY.
TOMÁS HERRAN.

PANAMA REPUBLIC

NOVEMBER 18, 1903

HAY-BUNAU-VARILLA TREATY

The United States of America and the Republic of Panama being desirous to insure the construction of a ship canal across the Isthmus of Panama to connect the Atlantic and the Pacific oceans, and the Congress of the United States of America having passed an act approved June 28, 1902, in furtherance of that object, by which the President of the United States is authorized to acquire within a reasonable time the control of the necessary territory of the Republic of Colombia, and the sovereignty of such territory being actually vested in the Republic of Panama, the high contracting parties have resolved for that purpose to conclude a convention and have accordingly appointed as their plenipotentiaries,—The President of the United States of America, JOHN HAY, Secretary of State, and The Government of the Republic of Panama, PHILIPPE BUNAU-VARILLA, Envoy Extraordinary and Minister Plenipotentiary of the Republic of Panama, thereunto specially empowered by said government, who after communicating with each other their respective full powers, found to be in good and due form, have agreed upon and concluded the following articles:

ARTICLE I.

The United States guarantees and will maintain the independence of the Republic of Panama.

ARTICLE II.

The Republic of Panama grants to the United States in perpetuity the use, occupation and control of a zone of land and land under water for the construction, maintenance, operation, sanitation and protection of said Canal of the width of ten miles extending to the distance of five miles on each side of the center line of the route of the Canal to be constructed; the said zone beginning in the Caribbean Sea three marine miles from mean low water mark and extending to and across the Isthmus of Panama into the Pacific Ocean to a distance of three marine miles from mean low water mark with the proviso that the cities of Panama and Colon and the harbors adjacent to said cities, which are included within the boundaries of the zone above described, shall not be included within this grant. The republic of Panama further grants to the United States in perpetuity the use, occupation and control of any other lands and waters outside of the zone above described which may be necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said Canal or of any auxiliary canals or other works necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said enterprise.

The Republic of Panama further grants in like manner to the United States in perpetuity all islands within the limits of the zone above described and in addition thereto the group of small islands in the Bay of Panama, named Perico, Naos, Culebra and Flamenco.

ARTICLE III.

The Republic of Panama grants to the United States all the rights, power and authority within the zone mentioned and described in Article II of this agreement and within the limits of all auxiliary lands and waters mentioned and described in said Article II which the United States would possess and exercise if it were the sovereign of the territory within which said lands and waters are located to the entire exclusion of the exercise by the Republic of Panama of any such sovereign rights, power or authority.

ARTICLE IV.

As rights subsidiary to the above grants the Republic of Panama grants in perpetuity to the United States the right to use the rivers, streams, lakes and other bodies of water within its limits for navigation, the supply of water or water-power or other purposes, so far as the use of said rivers, streams, lakes and bodies of water and the waters thereof may be necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said Canal.

ARTICLE V.

The Republic of Panama grants to the United States in perpetuity a monopoly for the construction, maintenance and operation of any system of communication by means of canal or railroad across its territory between the Caribbean Sea and the Pacific Ocean.

ARTICLE VI.

The grants herein contained shall in no manner invalidate the titles or rights of private land holders or owners of private property in the said zone or in or to any of the lands or waters granted to the United States by the provisions of any Article of this Treaty, nor shall they interfere with the rights of way over the public roads passing through the said zone or over any of the said lands or waters unless said rights of way or private rights shall conflict with rights herein granted to the United States in which case the rights of the United States shall be superior. All damages caused to the owners in this treaty or by reason of the operations of the United States, its agents or employees, of private lands or private property of any kind by reason of the grants contained or by reason of the construction, maintenance, operation, sanitation and protection of the said Canal or of the works of sanitation and protection herein provided for, shall be appraised and settled by a joint Commission appointed by the Governments of the United States and of the Republic of Panama, whose decisions as to such damages shall be final and whose awards as to such damages shall be paid solely by the United States. No part of the work on said Canal or the Panama Railroad or on any auxiliary works relating thereto and authorized by the terms of this treaty shall be prevented, delayed or impeded by or pending such proceedings to ascertain such damages. The appraisal of said private land and private property and the assessment of damages to them shall be based upon their value before the date of this convention.

ARTICLE VII.

The Republic of Panama grants to the United States within the limits of the cities of Panama and Colon and their adjacent harbors and within the territory adjacent thereto the right to acquire by purchase or by the exercise of the right of eminent domain, any lands, buildings, water rights or other properties necessary and convenient for the construction, maintenance, operation and protection of the Canal and of any works of sanitation, such as the collection and disposition of sewage and the distribution of water in the said cities of Panama and Colon, which, in the discretion of the United States may be necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said Canal and railroad. All such works of sanitation, collection and disposition of sewage and distribution of water in the cities of Panama and Colon shall be made at the expense of the United States, and the Government of the United States, its agents or nominees shall be authorized to impose and collect water rates and sewerage rates which shall be sufficient to provide for the payment of interest and the amortization of the principal of the cost of said works within a period of fifty years and upon the expiration of said term of fifty years the system of sewers and water works shall revert to and become the properties of the cities of Panama and Colon respectively, and the use of the water shall be free to the inhabitants of Panama and Colon, except to the extent that water rates may be necessary for the operation and maintenance of said system of sewers and waters.

The Republic of Panama agrees that the cities of Panama and Colon shall comply in perpetuity with the sanitary ordinances whether of a preventive or curative character prescribed by the United States and in case the Government of Panama is unable or fails in its duty to enforce this compliance by the cities of Panama and Colon with the sanitary ordinances of the United States the Republic of Panama grants to the United States the right and authority to enforce the same.

The same right and authority are granted to the United States for the maintenance of public order in the cities of Panama and Colon and the territories and harbors adjacent thereto in case the Republic of Panama should not be, in the judgment of the United States, able to maintain such order.

ARTICLE VIII.

The Republic of Panama grants to the United States all rights which it now has or hereafter may acquire to the property of the New Panama Canal Company and the Panama Railroad Company as a result of the transfer of sovereignty from the Republic of Colombia to the Republic of Panama over the Isthmus of Panama and authorizes the New Panama Canal Company to sell and transfer to the United States its rights, privileges, properties, and concessions as well as the Panama Railroad and all the shares or part of the shares of that company; but the public lands situated outside of the zone described in Article II of this treaty now included in the concessions to both said enterprises and not required in the construction or operation of the Canal shall revert to the Republic of Panama except any property now owned by or in the possession of said companies within Panama or Colon or the ports or terminals thereof.

ARTICLE IX.

The United States agrees that the ports at either entrance of the Canal and the waters thereof and the Republic of Panama agrees that the towns of Panama and Colon shall be free for all time so that there shall not be imposed or collected custom house tolls, tonnage, anchorage, lighthouse, wharf, pilot, or quarantine dues or any other charges or taxes of any kind upon any vessel using or passing through the Canal or belonging to or employed by the United States, directly or indirectly, in connection with the construction, maintenance, operation, sanitation and protection of the main Canal, or auxiliary works, or upon the cargo, officers, crew, or passengers of any such vessels, except such tolls and charges as may be imposed by the United States for the use of the Canal and other works, and except tolls and charges imposed by the Republic of Panama upon

merchandise destined to be introduced for the consumption of the rest of the Republic of Panama, and upon vessels touching at the ports of Colon and Panama and which do not cross the Canal.

The Government of the Republic of Panama shall have the right to establish in such ports and in the towns of Panama and Colon such houses and guards as it may deem necessary to collect duties on importations destined to other portions of Panama and to prevent contraband trade. The United States shall have the right to make use of the towns and harbors of Panama and Colon as places of anchorage, and for making repairs, for loading, unloading, depositing, or transshiping cargoes either in transit or destined for the service of the Canal and for other works pertaining to the Canal.

ARTICLE X.

The Republic of Panama agrees that there shall not be imposed any taxes, national, municipal, departmental, or of any other class upon the Canal, the railways and auxiliary works, tugs and other vessels employed in the service of the Canal, store houses, work shops, offices, quarters for laborers, factories of all kinds, warehouses, wharves, machinery and other works, property, and effects appertaining to the Canal or railroad and auxiliary works, or their officers or employees, situated within the cities of Panama and Colon, and that there shall not be imposed contributions or charges of a personal character of any kind upon officers, employees, laborers, and other individuals in the service of the Canal and railroad and auxiliary works.

ARTICLE XI.

The United States agrees that the official dispatches of the Government of the Republic of Panama shall be transmitted over any telegraph and telephone lines established for canal purposes and used for public and private business at rates not higher than those required from officials in the service of the United States.

ARTICLE XII.

The Government of the Republic of Panama shall permit the immigration and free access to the lands and workshops of the Canal and its auxiliary works of all employees and workmen of whatever nationality under contract to work upon or seeking employment upon or in any wise connected with the said Canal and its auxiliary works, with their respective families and all such persons shall be free and exempt from the military service of the Republic of Panama.

ARTICLE XIII.

The United States may import at any time into the said zone and auxiliary lands, free of custom duties, imposts, taxes, or other charges, and without any restrictions, any and all vessels, dredges, engines, cars, machinery, tools, explosives, materials, supplies, and other articles necessary and convenient in the construction, maintenance, operation, sanitation and protection of the Canal and auxiliary works, and all provisions, medicines, clothing, supplies and other things necessary and convenient for the officers, employees, workmen and laborers in the service and employ of the United States and for their families. If any such articles are disposed of for use outside of the zone and auxiliary lands granted to the United States and within the territory of the Republic; they shall be subject to the same import or other duties as like articles imported under the laws of the Republic of Panama.

ARTICLE XIV.

As the price or compensation for the rights, powers and privileges granted in this convention by the Republic of Panama to the United States, the Government of the United States agrees to pay to the Republic of Panama the sum of ten million dollars ($10,000,000) in gold coin of the United States on the exchange of the ratification of this convention and also an annual payment during the life of this convention of two hundred and fifty thousand dollars ($250,000) in like gold coin, beginning nine years after the date aforesaid.

The provisions of this Article shall be in addition to all other benefits assured to the Republic of Panama under this convention.

But no delay or difference of opinion under this Article or any other provisions of this treaty shall affect or interrupt the full operation and effect of this convention in all other respects.

ARTICLE XV.

The joint commission referred to in Article VI shall be established as follows:

The President of the United States shall nominate two persons and the President of the Republic of Panama shall nominate two persons and they shall proceed to a decision; but in case of disagreement of the Commission (by reason of their being equally divided in conclusion) an umpire shall be appointed by the two Governments who shall render the decision. In the event of the death, absence, or incapacity of a Commissioner or Umpire, or of his omitting, declining or ceasing to act, his place shall be filled by the appointment of another person in the manner above indicated. All decisions by a majority of the Commission or by the umpire shall be final.

ARTICLE XVI.

The two Governments shall make adequate provision by future agreement for the pursuit, capture, imprisonment, detention and delivery within said zone and auxiliary lands to the authorities of the Republic of Panama of persons charged with the commitment of crimes, felonies or misdemeanors without said zone and for the pursuit, capture, imprisonment detention and delivery without said zone to the authorities of the United States of persons charged with the commitment of crimes, felonies, and misdemeanors within said zone and auxiliary lands.

ARTICLE XVII.

The Republic of Panama grants to the United States the use of all the ports of the Republic open to commerce as places of refuge for any vessels employed in the Canal enterprise, and for all vessels passing or bound to pass through the Canal which may be in distress and be driven to seek refuge in said ports. Such vessels shall be exempt from

anchorage and tonnage dues on the part of the Republic of Panama.

ARTICLE XVIII.

The Canal, when constructed, and the entrances thereto shall be neutral in perpetuity, and shall be opened upon the terms provided for by Section I of Article three of, and in conformity with all the stipulations of, the treaty entered into by the Governments of the United States and Great Britain on November 18, 1901.

ARTICLE XIX.

The Government of the Republic of Panama shall have the right to transport over the Canal its vessels and its troops and munitions of war in such vessels at all times without paying charges of any kind. The exemption is to be extended to the auxiliary railway for the transportation of persons in the service of the Republic of Panama, or of the police force charged with the preservation of public order outside of said zone, as well as to their baggage, munitions of war and supplies.

ARTICLE XX.

If by virtue of any existing treaty in relation to the territory of the Isthmus of Panama, whereof the obligations shall descend or be assumed by the Republic of Panama, there may be any privilege or concession in favor of the Government or the citizens and subjects of a third power relative to an interoceanic means of communication which in any of its terms may be incompatible with the terms of the present convention, the Republic of Panama agrees to cancel or modify such treaty in due form, for which purpose it shall give to the said third power the requisite notification within the term of four months from the date of the present convention, and in case the existing treaty contains no clause permitting its modifications or annulment, the Republic of Panama agrees to procure its modifications or annulment in such form that there shall not exist any conflict with the stipulations of the present convention.

ARTICLE XXI.

The rights and privileges granted by the Republic of Panama to the United States in the preceding Articles are understood to be free of all anterior debts, liens, trusts, or liabilities, or concessions or privileges to other Governments, corporations, syndicates or individuals, and consequently, if there should arise any claims on account of the present concessions and privileges or otherwise, the claimants shall resort to the Government of the Republic of Panama and not to the United States for any indemnity or compromise which may be required.

ARTICLE XXII.

The Republic of Panama renounces and grants to the United States the participation to which it might be entitled in the future earnings of the Canal under Article XV of the concessionary contract with Lucien N. B. Wyse now owned by the New Panama Canal Company and any and all other rights or claims of a pecuniary nature arising under or relating to said concession, or arising under or relating to the concessions to the Panama Railroad Company or any extension or modification thereof; and it likewise renounces, confirms and grants to the United States, now and hereafter, all the rights and property reserved in the said concessions which otherwise would belong to Panama at or before the expiration of the terms of ninety-nine years of the concessions granted to or held by the above mentioned party and companies, and all right, title and interest which it now has or may hereafter have, in and to the lands, canal, works, property and rights held by the said companies under said concessions or otherwise, and acquired or to be acquired by the United States from or through the New Panama Canal Company, including any property and rights which might or may in the future either by lapse of time, forfeiture or otherwise, revert to the Republic of Panama under any contracts or concessions, with said Wyse, the Universal Panama Canal Company, the Panama Railroad Company and the New Panama Canal Company.

The aforesaid rights and property shall be and are free and released from any present or reversionary interest in or claims of Panama and the title of the United States thereto upon consummation of the contemplated purchase by the United States from the New Panama Canal Company, shall be absolute, so far as concerns the Republic of Panama, excepting always the rights of the Republic specifically secured under this treaty.

ARTICLE XXIII.

If it should become necessary at any time to employ armed forces for the safety or protection of the Canal, or of the ships that make use of the same, or the railways and auxiliary works, the United States shall have the right, at all times and in its discretion, to use its police and its land and naval forces or to establish fortifications for these purposes.

ARTICLE XXIV.

No change either in the Government or in the laws and treaties of the Republic of Panama shall, without the consent of the United States, affect any right of the United States under the present convention, or under any treaty stipulation between the two countries that now exists or may hereafter exist touching the subject matter of this convention.

If the Republic of Panama shall hereafter enter as a constituent into any other Government or into any union or confederation of states, so as to merge her sovereignty or independence in such Government, union or confederation, the rights of the United States under this convention shall not be in any respect lessened or impaired.

ARTICLE XXV.

For the better performance of the engagements of this convention and to the end of the efficient protection of the Canal and the preservation of its neutrality, the Government of the Republic of Panama will sell or lease to the United States lands adequate and necessary for naval or coaling stations on the Pacific coast and on the western Caribbean

coast of the Republic at certain points to be agreed upon with the President of the United States.

This convention when signed by the Plenipotentiaries of the Contracting Parties shall be ratified by the respective Governments and the ratifications shall be exchanged at Washington at the earliest date possible.

In faith whereof the respective Plenipotentiaries have signed the present convention in duplicate and have hereunto affixed their respective seals.

Done at the City of Washington the 18th day of November in the year of our Lord nineteen hundred and three. JOHN HAY.
P. BUNAU VARILLA.

COLOMBIA-PANAMA REPUBLIC

JANUARY 9, 1909

ROOT-CORTES, ROOT-AROSEMENA, AND CORTES-AROSEMENA TREATIES

In an effort to compose the differences between the United States and Colombia arising out of the revolution at Panama, and the differences between Colombia and the new Republic of Panama, three treaties were signed at Washington on Jan. 9, 1909, between Secretary Root and Minister Cortes of Colombia; Secretary Root and Minister Arosemena of Panama; and Ministers Cortes and Arosemena. The treaties were of a tripartite nature, each depending on the others. They were ratified by the United States Senate on Feb. 24, 1909, but did not become operative by reason of the failure of Colombia to accept them.

The Root-Cortes treaty provided for peace and friendship between the United States and Colombia; granted freedom of passage through the Panama Canal to the troops and war ships of Colombia; exempted provisions, cattle, and other Colombia products from duty in the Canal Zone; granted free passage of Colombian mails in the zone; agreed to pay $250,000 annually to Colombia instead of Panama, from 1908 to 1917 inclusive, on condition that Colombia should recognize the independence of Panama and that Panama should be released from obligation to pay any of the public debt of Colombia; granted the use of ports in Colombia to American vessels; renounced all Colombia's rights in all canal contracts and concessions; and provided for a revision of the old treaty of 1846 (New Granada).

The Root-Arosemena treaty provided that the annual payment of $250,000 from the United States to Panama should begin four years instead of nine years from Nov. 18, 1903; consented to the assignment and transfer to Colombia of the first ten annual payments; provided for the delimitation of the cities of Panama and Colon and the adjacent harbors, and authorized the purchase by Panama of such portions of the waterworks in those cities as lie outside of the Canal Zone; provided for the arbitration of all questions arising out of the Hay-Bunau-Varilla treaty; and provided for reciprocal liberty of commerce and navigation, and granted to Panama most-favored-nation rights in the use of the Panama Canal facilities.

The Cortes-Arosemena treaty provided for the recognition of the independence of Panama by Colombia; provided for mutual and inviolable peace and friendship between Colombia and Panama; assigned to Colombia the first ten annual payments of $250,000 each payable by the United States to Panama under the Hay-Bunau-Varilla treaty; released Panama from the payment of any part of the public debt of Colombia; released each nation from all pecuniary claims held by the other on Nov. 3, 1903; confirmed the abandonment by Panama of all right and title to stock of the New Panama Canal Co.; granted reciprocal most-favored-nation rights to the citizens of each country, and established the status of citizens in the respective territories; provided that neither republic should extend its territory by force at the expense of the other; provided for the negotiation of additional treaties covering commerce, arbitration, and other relations; and provided for the establishment of the boundary line between Colombia and Panama.

COLOMBIA

APRIL 6, 1914

THOMSON-URRUTIA TREATY

The failure of Colombia to ratify the tripartite treaties was followed by prolonged negotiations between the United States and Colombia, looking to the settlement of their differences. These negotiations resulted in the signing of a treaty on April 6, 1914, between the United States Minister to Colombia, Thaddeus A. Thomson, and Francisco José Urrutia, Minister for Foreign Affairs of Colombia, together with five other plenipotentiaries representing Colombia. This treaty was

transmitted to the Senate by President Wilson on June 16, 1914.

On account of the allegation that the first article of the treaty constituted an "apology" by the United States for the incidents resulting in the independence of Panama, and also on account of the proposed payment of $25,000,000 to Colombia, this treaty met with opposition in the United States and it was still pending in the Senate when Congress adjourned March 4, 1915.

The United States of America and the Republic of Colombia, being desirous to remove all the misunderstandings growing out of the political events in Panama in November, 1903; to restore the cordial friendship that formerly characterized the relations between the two countries, and also to define and regulate their rights and interests in respect of the interoceanic canal which the Government of the United States is constructing across the Isthmus of Panama, have resolved for this purpose to conclude a Treaty and have accordingly appointed as their Plenipotentiaries:

His Excellency the President of the United States of America, Thaddeus Austin Thomson, Envoy Extraordinary and Minister Plenipotentiary of the United States of America to the Government of the Republic of Colombia; and

His Excellency the President of the Republic of Colombia, Francisco José Urrutia, Minster for Foreign Affairs; Marco Fidel Suárez, First Designate to exercise the Executive Power; Nicolás Esguerra, Ex-Minister of State; José Maria González Valencia, Senator; Rafael Uribe Uribe, Senator; and Antonio José Uribe, President of the House of Representatives;

Who, after communicating to each other their respective full powers, which were found to be in due and proper form, have agreed upon the following:

ARTICLE I.

The Government of the United States of America, wishing to put at rest all controversies and differences with the Republic of Colombia arising out of the events from which the present situation on the Isthmus of Panama resulted, expresses, in its own name and in the name of the people of the United States, sincere regret that anything should have occurred to interrupt or to mar the relations of cordial friendship that had so long subsisted between the two nations.

The Government of the Republic of Colombia, in its own name and in the name of the Colombian people, accepts this declaration in the full assurance that every obstacle to the restoration of complete harmony between the two countries will thus disappear.

ARTICLE II.

The Republic of Colombia shall enjoy the following rights in respect to the interoceanic Canal and the Panama Railway:

1. The Republic of Colombia shall be at liberty at all times to transport through the interoceanic Canal its troops, materials of war and ships of war, even in case of war between Colombia and another country, without paying any charges to the United States.

2. The products of the soil and industry of Colombia passing through the Canal, as well as the Colombian mails, shall be exempt from any charge or duty other than those to which the products and mails of the United States may be subject. The products of the soil and industry of Colombia, such as cattle, salt and provisions, shall be admitted to entry in the Canal Zone, and likewise in the islands and main land occupied or which may be occupied by the United States as auxiliary and accessory thereto, without paying other duties or charges than those payable by similar products of the United States.

3. Colombian citizens crossing the Canal Zone shall, upon production of proper proof of their nationality, be exempt from every toll, tax or duty to which citizens of the United States are not subject.

4. During the construction of the Interoceanic Canal and afterwards, whenever traffic by the Canal is interrupted or whenever it shall be necessary for any other reason to use the railway, the troops, materials of war, products and mails of the Republic of Colombia, as above mentioned, shall, even in case of war between Colombia and another country, be transported on the Railway between Ancon and Cristobal or on any other Railway substituted therefor, paying only the same charges and duties as are imposed upon the troops, materials of war, products and mails of the United States. The officers, agents and employees of the Government of Colombia shall, upon production of proper proof of their official character or their employment, also be entitled to passage on the said Railway on the same terms as officers, agents and employees of the Government of the United States. The provisions of this paragraph shall not, however, apply in case of war between Colombia and Panama.

5. Coal, petroleum and sea salt, being the products of Colombia, passing from the Atlantic coast of Colombia to any Colombian port on the Pacific coast, and vice versa, shall be transported over the aforesaid Railway free of any charge except the actual cost of handling and transportation, which shall not in any case exceed one half of the ordinary freight charges levied upon similar products of the United States passing over the Railway and in transit from one port to another of the United States.

ARTICLE III.

The United States of America agrees to pay to the Republic of Colombia, within six months after the exchange of the ratifications of the present Treaty, the sum of twenty-five million dollars, gold, United States money.

ARTICLE IV.

The Republic of Colombia recognizes Panama as an independent nation and taking as a basis the Colombian law of June 9, 1855, agrees that the boundary shall be the following: From Cape

Tiburon to the headwaters of the Rio de la Miel and following the mountain chain by the ridge of Gandi to the Sierra de Chugargun and that of Mali going down by the ridges of Nigue to the heights of Aspave and from thence to a point on the Pacific half way between Cocalito and La Arvita.

In consideration of this recognition, the Government of the United States will, immediately after the exchange of the ratifications of the present Treaty, take the necessary steps in order to obtain from the Government of Panama the despatch of a duly accredited agent to negotiate and conclude with the Government of Colombia a Treaty of Peace and Friendship, with a view to bring about both the establishment of regular diplomatic relations between Colombia and Panama and the adjustment of all questions of pecuniary liability as between the two countries, in accordance with recognized principles of law and precedents.

ARTICLE V.

The present Treaty shall be approved and ratified by the High Contracting Parties in conformity with their respective laws, and the ratifications thereof shall be exchanged in the City of Bogotá as soon as may be possible.

In faith whereof, the said Plenipotentiaries have signed the present Treaty in duplicate and have hereunto affixed their respective seals.

Done at the City of Bogotá, the sixth day of April in the year of our Lord nineteen hundred and fourteen.

THADDEUS AUSTIN THOMSON.
FRANCISCO JOSÉ URRUTIA.
MARCO FIDEL SUÁREZ.
NICOLÁS ESGUERRA.
JOSÉ MARIA GONZÁLES VALENCIA.
RAFAEL URIBE URIBE.
ANTONIO JOSÉ URIBE.

LAWS OF THE UNITED STATES RELATING TO THE PANAMA CANAL

THE SPOONER ACT

APPROVED JUNE 28, 1902

An Act To provide for the construction of a canal connecting the waters of the Atlantic and Pacific oceans.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States is hereby authorized to acquire, for and on behalf of the United States, at a cost not exceeding forty millions of dollars, the rights, privileges, franchises, concessions, grants of land, right of way, unfinished work, plants, and other property, real, personal, and mixed, of every name and nature, owned by the New Panama Canal Company, of France, on the Isthmus of Panama, and all its maps, plans, drawings, records on the Isthmus of Panama and in Paris, including all the capital stock, not less, however, than sixty-eight thousand eight hundred and sixty-three shares of the Panama Railroad Company, owned by or held for the use of said canal company, provided a satisfactory title to all of said property can be obtained.

SEC. 2. That the President is hereby authorized to acquire from the Republic of Colombia, for and on behalf of the United States, upon such terms as he may deem reasonable, perpetual control of a strip of land, the territory of the Republic of Colombia, not less than six miles in width, extending from the Caribbean Sea to the Pacific Ocean, and the right to use and dispose of the waters thereon, and to excavate, construct, and to perpetually maintain, operate, and protect thereon a canal, of such depth and capacity as will afford convenient passage of ships of the greatest tonnage and draft now in use, from the Caribbean Sea to the Pacific Ocean, which control shall include the right to perpetually maintain and operate the Panama Railroad, if the ownership thereof, or a controlling interest therein shall have been acquired by the United States, and also jursidiction over said strip and the ports at the ends thereof to make such police and sanitary rules and regulations as shall be necessary to preserve order and preserve the public health thereon, and to establish such judicial tribunals as may be agreed upon thereon as may be necessary to enforce such rules and regulations.

The President may acquire such additional territory and rights from Colombia as in his judgment will facilitate the general purpose hereof.

SEC. 3. That when the President shall have arranged to secure a satisfactory title to the property of the New Panama Canal Company, as provided in section one hereof, and shall have obtained by treaty control of the necessary territory from the Republic of Colombia, as provided in section two hereof, he is authorized to pay for the property of the New Panama Canal Company forty millions of dollars and to the Republic of Colombia such sum as shall have been agreed upon, and a sum sufficient for both said purposes is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be paid on warrant or warrants drawn by the President.

The President shall then through the Isthmian Canal Commission hereinafter authorized cause to be excavated, constructed, and completed, utilizing to that end as far as practicable the work heretofore done by the New Panama Canal Company, of France, and its predecessor company, a ship canal from the Caribbean Sea to the Pacific Ocean. Such canal shall be of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draft now in use, and such as may be reasonably anticipated, and shall be supplied with all necessary locks and other appliances to meet the necessities of vessels passing through the same from ocean to ocean; and he shall also cause to be constructed such safe and commodious harbors at the termini of said canal, and make such provisions for defense

as may be necessary for the safety and protection of said canal and harbors. That the President is authorized for the purposes aforesaid to employ such persons as he may deem necessary, and to fix their compensation.

SEC. 4. That should the President be unable to obtain for the United States a satisfactory title to the property of the New Panama Canal Company and the control of the necessary territory of the Republic of Colombia and the rights mentioned in sections one and two of this Act, within a reasonable time and upon reasonable terms, then the President, having first obtained for the United States perpetual control by treaty of the necessary territory from Costa Rica and Nicaragua, upon terms which he may consider reasonable, for the construction, perpetual maintenance, operation, and protection of a canal connecting the Caribbean Sea with the Pacific Ocean by what is commonly known as the Nicaragua route, shall through the said Isthmian Canal Commission cause to be excavated and constructed a ship canal and waterway from a point on the shore of the Caribbean Sea near Greytown, by way of Lake Nicaragua, to a point near Brito on the Pacific Ocean. Said canal shall be of sufficient capacity and depth to afford convenient passage for vessels of the largest tonnage and greatest draft now in use, and such as may be reasonably anticipated, and shall be supplied with all necessary locks and other appliances to meet the necessities of vessels passing through the same from ocean to ocean; and he shall also construct such safe and commodious harbors at the termini of said canal as shall be necessary for the safe and convenient use thereof, and shall make such provisions for defense as may be necessary for the safety and protection of said harbors and canal; and such sum or sums of money as may be agreed upon by such treaty as compensation to be paid to Nicaragua and Costa Rica for the concessions and rights hereunder provided to be acquired by the United States, are hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be paid on warrant or warrants drawn by the President.

The President shall cause the said Isthmian Canal Commission to make such surveys as may be necessary for said canal and harbors to be made, and in making such surveys and in the construction of said canal may employ such persons as he may deem necessary and may fix their compensation.

In the excavation and construction of said canal the San Juan River and Lake Nicaragua, or such parts of each as may be made available, shall be used.

SEC. 5. That the sum of ten million dollars is hereby appropriated, out of any money in the Treasury not otherwise appropriated, toward the project herein contemplated by either route so selected.

And the President is hereby authorized to cause to be entered into such contract or contracts as may be deemed necessary for the proper excavation, construction, completion, and defense of said canal, harbors, and defenses, by the route finally determined upon under the provisions of this Act. Appropriations therefor shall from time to time be hereafter made, not to exceed in the aggregate the additional sum of one hundred and thirty-five millions of dollars should the Panama route be adopted, or one hundred and eighty millions of dollars should the Nicaragua route be adopted.

SEC. 6. That in any agreement with the Republic of Colombia, or with the States of Nicaragua and Costa Rica, the President is authorized to guarantee to said Republic or to said States the use of said canal and harbors, upon such terms as may be agreed upon, for all vessels owned by said States or by citizens thereof.

SEC. 7. That to enable the President to construct the canal and works appurtenant thereto as provided in this Act, there is hereby created the Isthmian Canal Commission, the same to be composed of seven members, who shall be nominated and appointed by the President, by and with the advice and consent of the Senate, and who shall serve until the completion of said canal unless sooner removed by the President, and one of whom shall be named as the chairman of said Commission. Of the seven members of said Commission at least four of them shall be persons learned and skilled in the science of engineering, and of the four at least one shall be an officer of the United States Army, and at least one other shall be an officer of the United States Navy, the said officers respectively being either upon the active or the retired list of the Army or of the Navy. Said commissioners shall each receive such compensation as the President shall prescribe until the same shall have been otherwise fixed by the Congress. In addition to the members of said Isthmian Canal Commission, the President is hereby authorized through said Commission to employ in said service any of the engineers of the United States Army at his discretion, and likewise to employ any engineers in civil life, at his discretion, and any other persons necessary for the proper and expeditious prosecution of said work. The compensation of all such engineers and other persons employed under this Act shall be fixed by said Commission, subject to the approval of the President. The official salary of any officer appointed or employed under this Act shall be deducted from the amount of salary or compensation provided by or which shall be fixed under the terms of this Act. Said Commission shall in all matters be subject to the direction and control of the President, and shall make to the President annually and at such other periods as may be required, either by law or by the order of the President, full and complete reports of all their actings and doings and of all moneys received and expended in the construction of said work and in the performance of their duties in connection therewith, which said reports shall be by the President transmitted to Congress. And the said Commission shall furthermore give to Congress, or either House of Congress, such information as may at any time be required either by Act of Congress or by the order of either House of Congress. The President shall cause to be provided and assigned for the use of the Commission such offices as may, with the suitable equipment of the same, be necessary and proper, in his discretion, for the proper discharge of the duties thereof.

SEC. 8. That the Secretary of the Treasury is hereby authorized to borrow on the credit of the United States from time to time, as the proceeds

may be required to defray expenditures authorized by this Act (such proceeds when received to be used only for the purpose of meeting such expenditures), the sum of one hundred and thirty million dollars, or so much thereof as may be necessary, and to prepare and issue therefor coupon or registered bonds of the United States in such form as he may prescribe, and in denominations of twenty dollars or some multiple of that sum, redeemable in gold coin at the pleasure of the United States after ten years from the date of their issue, and payable thirty years from such date, and bearing interest payable quarterly in gold coin at the rate of two per centum per annum; and the bonds herein authorized shall be exempt from all taxes or duties of the United States, as well as from taxation in any form by or under State, municipal, or local authority: *Provided*, That said bonds may be disposed of by the Secretary of the Treasury at not less than par, under such regulations as he may prescribe, giving to all citizens of the United States an equal opportunity to subscribe therefor, but no commissions shall be allowed or paid thereon; and a sum not exceeding one-tenth of one per centum of the amount of the bonds herein authorized is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to pay the expense of preparing, advertising, and issuing the same.

TEMPORARY GOVERNMENT

Approved April 28, 1904

An Act To provide for the temporary government of the Canal Zone at Panama, the protection of the canal works, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President is hereby authorized, upon the acquisition of the property of the New Panama Canal Company and the payment to the Republic of Panama of the ten millions of dollars provided by article fourteen of the treaty between the United States and the Republic of Panama, the ratifications of which were exchanged on the twenty-sixth day of February, nineteen hundred and four, to be paid to the latter Government, to take possession of and occupy on behalf of the United States the zone of land and land under water of the width of ten miles, extending to the distance of five miles on each side of the center line of the route of the canal to be constructed thereon, which said zone begins in the Caribbean Sea three marine miles from mean low-water mark and extends to and across the Isthmus of Panama into the Pacific Ocean to the distance of three marine miles from mean low-water mark, and also of all islands within said zone, and in addition thereto the group of islands in the Bay of Panama named Perico, Naos, Culebra, and Flamenco, and, from time to time, of any lands and waters outside of said zone which may be necessary and convenient for the construction, maintenance, operation, sanitation, and protection of the said canal, or of any auxiliary canals or other works necessary and convenient for the construction, maintenance, operation, sanitation, and protection of said enterprise, the use, occupation, and control whereof were granted to the United States by article two of said treaty. The said zone is hereinafter referred to as "the Canal Zone." The payment of the ten millions of dollars provided by article fourteen of said treaty shall be made in lieu of the indefinite appropriation made in the third section of the Act of June twenty-eighth, nineteen hundred and two, and is hereby appropriated for said purpose.

Sec. 2. That until the expiration of the Fifty-eighth Congress, unless provision for the temporary government of the Canal Zone be sooner made by Congress, all the military, civil, and judicial powers as well as the power to make all rules and regulations necessary for the government of the Canal Zone and all the rights, powers, and authority granted by the terms of said treaty to the United States shall be vested in such person or persons and shall be exercised in such manner as the President shall direct for the government of said Zone and maintaining and protecting the inhabitants thereof in the free enjoyment of their liberty, property, and religion.

THE PANAMA CANAL ACT

Approved August 24, 1912

An Act To provide for the opening, maintenance, protection, and operation of the Panama Canal, and the sanitation and government of the Canal Zone.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the zone of land and land under water of the width of ten miles extending to the distance of five miles on each side of the center line of the route of the canal now being constructed thereon, which zone begins in the Caribbean Sea three marine miles from mean low-water mark and extends to and across the Isthmus of Panama into the Pacific Ocean to the distance of three marine miles from mean low-water mark, excluding therefrom the cities of Panama and Colon and their adjacent harbors located within said zone, as excepted in the treaty with the Republic of Panama dated November eighteenth, nineteen hundred and three, but including all islands within said described zone, and in addition thereto the group of islands in the Bay of Panama named Perico, Naos, Culebra, and Flamenco, and any lands and waters outside of said limits above described which are necessary or convenient or from time to time may become necessary or convenient for the construction, maintenance, operation, sanitation, or protection of the

said canal or of any auxiliary canals, lakes, or other works necessary or convenient for the construction, maintenance, operation, sanitation, or protection of said canal, the use, occupancy, or control whereof were granted to the United States by the treaty between the United States and the Republic of Panama, the ratifications of which were exchanged on the twenty-sixth day of February, nineteen hundred and four, shall be known and designated as the Canal Zone, and the canal now being constructed thereon shall hereafter be known and designated as the Panama Canal. The President is authorized, by treaty with the Republic of Panama, to acquire any additional land or land under water not already granted, or which was excepted from the grant, that he may deem necessary for the operation, maintenance, sanitation, or protection of the Panama Canal, and to exchange any land or land under water not deemed necessary for such purposes for other land or land under water which may be deemed necessary for such purposes, which additional land or land under water so acquired shall become part of the Canal Zone.

SEC. 2. That all laws, orders, regulations, and ordinances adopted and promulgated in the Canal Zone by order of the President for the government and sanitation of the Canal Zone and the construction of the Panama Canal are hereby ratified and confirmed as valid and binding until Congress shall otherwise provide. The existing courts established in the Canal Zone by Executive order are recognized and confirmed to continue in operation until the courts provided for in this Act shall be established.

SEC. 3. That the President is authorized to declare by Executive order that all land and land under water within the limits of the Canal Zone is necessary for the construction, maintenance, operation, sanitation, or protection of the Panama Canal, and to extinguish, by agreement when advisable, all claims and titles of adverse claimants and occupants. Upon failure to secure by agreement title to any such parcel of land or land under water the adverse claim or occupancy shall be disposed of and title thereto secured in the United States and compensation therefor fixed and paid in the manner provided in the aforesaid treaty with the Republic of Panama, or such modification of such Treaty as may hereafter be made.

SEC. 4. That when in the judgment of the President the construction of the Panama Canal shall be sufficiently advanced toward completion to render the further services of the Isthmian Canal Commission unnecessary the President is authorized by Executive order to discontinue the Isthmian Canal Commission, which, together with the present organization, shall then cease to exist; and the President is authorized thereafter to complete, govern, and operate the Panama Canal and govern the Canal Zone, or cause them to be completed, governed, and operated, through a governor of the Panama Canal and such other persons as he may deem competent to discharge the various duties connected with the completion, care, maintenance, sanitation, operation, government, and protection of the canal and Canal Zone. If any of the persons appointed or employed as aforesaid shall be persons in the military or naval service of the United States, the amount of the official salary paid to any such person shall be deducted from the amount of salary or compensation provided by or which shall be fixed under the terms of this Act. The governor of the Panama Canal shall be appointed by the President, by and with the advice and consent of the Senate, commissioned for a term of four years, and until his successor shall be appointed and qualified. He shall receive a salary of ten thousand dollars a year. All other persons necessary for the completion, care, management, maintenance, sanitation, government, operation, and protection of the Panama Canal and Canal Zone shall be appointed by the President, or by his authority, removable at his pleasure, and the compensation of such persons shall be fixed by the President, or by his authority, until such time as Congress may by law regulate the same, but salaries or compensation fixed hereunder by the President shall in no instance exceed by more than twenty-five per centum the salary or compensation paid for the same or similar services to persons employed by the Government in continental United States. That upon the completion of the Panama Canal the President shall cause the same to be officially and formally opened for use and operation.

Before the completion of the canal, the Commission of Arts may make report to the President of their recommendation regarding the artistic character of the structures of the canal, such report to be transmitted to Congress.

SEC. 5. That the President is hereby authorized to prescribe and from time to time change the tolls that shall be levied by the Government of the United States for the use of the Panama Canal: *Provided*, That no tolls, when prescribed as above, shall be changed, unless six months' notice thereof shall have been given by the President by proclamation. No tolls shall be levied upon vessels engaged in the coastwise trade of the United States. That section forty-one hundred and thirty-two of the Revised Statutes is hereby amended to read as follows:

"SEC. 4132. Vessels built within the United States and belonging wholly to citizens thereof; and vessels which may be captured in war by citizens of the United States and lawfully condemned as prize, or which may be adjudged to be forfeited for a breach of the laws of the United States; and seagoing vessels, whether steam or sail, which have been certified by the Steamboat Inspection Service as safe to carry dry and perishable cargo, not more than five years old at the time they apply for registry, wherever built, which are to engage only in trade with foreign countries or with the Philippine Islands and the islands of Guam and Tutuila, being wholly owned by citizens of the United States or corporations organized and chartered under the laws of the United States or of any State thereof, the president and managing directors of which shall be citizens of the United States or corporations organized and chartered under the laws of the United States or of any State thereof, the President and managing directors of which shall be citizens of the United States, and no others, may be registered as directed in this title. Foreign-built vessels registered pursuant to this Act shall not engage in the

coastwise trade: *Provided*, That a foreign-built yacht, pleasure boat, or vessel not used or intended to be used for trade admitted to American registry pursuant to this section shall not be exempt from the collection of ad valorem duty provided in section thirty-seven of the Act approved August fifth, nineteen hundred and nine, entitled 'An Act to provide revenue, equalize duties, and encourage the industries of the United States, and for other purposes.' That all materials of foreign production which may be necessary for the construction or repair of vessels built in the United States and all such materials necessary for the building or repair of their machinery and all articles necessary for their outfit and equipment may be imported into the United States free of duty under such regulations as the Secretary of the Treasury may prescribe: *Provided further*, That such vessels so admitted under the provisions of this section may contract with the Postmaster General under the Act of March third, eighteen hundred and ninety-one, entitled 'An Act to provide for ocean mail service between the United States and foreign ports, and to promote commerce,' so long as such vessels shall in all respects comply with the provisions and requirements of said Act."

Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise, and may be based on one form of tonnage for warships and another for ships of commerce. The rate of tolls may be lower upon vessels in ballast than upon vessels carrying passengers or cargo. When based upon net registered tonnage for ships of commerce the tolls shall not exceed one dollar and twenty-five cents per net registered ton, nor be less, other than for vessels of the United States and its citizens, than the estimated proportionate cost of the actual maintenance and operation of the canal subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three. If the tolls shall not be based upon net registered tonnage, they shall not exceed the equivalent of one dollar and twenty-five cents per net registered ton as nearly as the same may be determined, nor be less than the equivalent of seventy-five cents per net registered ton. The toll for each passenger shall not be more than one dollar and fifty cents. The President is authorized to make and from time to time amend regulations governing the operation of the Panama Canal, and the passage and control of vessels through the same or any part thereof, including the locks and approaches thereto, and all rules and regulations affecting pilots and pilotage in the canal or the approaches thereto through the adjacent waters.

Such regulations shall provide for prompt adjustment by agreement and immediate payment of claims for damages which may arise from injury to vessels, cargo, or passengers from the passing of vessels through the locks under the control of those operating them under such rules and regulations. In case of disagreement suit may be brought in the district court of the Canal Zone against the governor of the Panama Canal. The hearing and disposition of such cases shall be expedited and the judgment shall be immediately paid out of any moneys appropriated or alloted for canal operation.

The President shall provide a method for the determination and adjustment of all claims arising out of personal injuries to employees thereafter occurring while directly engaged in actual work in connection with the construction, maintenance, operation, or sanitation of the canal or of the Panama Railroad, or of any auxiliary canals, locks, or other works necessary and convenient for the construction, maintenance, operation, or sanitation of the canal, whether such injuries result in death or not, and prescribe a schedule of compensation therefor, and may revise and modify such method and schedule at any time; and such claims, to the extent they shall be allowed on such adjustment, if allowed at all, shall be paid out of the moneys hereafter appropriated for that purpose or out of the funds of the Panama Railroad Company, if said company was responsible for said injury, as the case may require. And after such method and schedule shall be provided by the President, the provisions of the Act entitled "An Act granting to certain employees of the United States the right to receive from it compensation for injuries sustained in the course of their employment," approved May thirtieth, nineteen hundred and eight, and of the Act entitled "An Act relating to injured employees on the Isthmian Canal," approved February twenty-fourth, nineteen hundred and nine, shall not apply to personal injuries thereafter received and claims for which are subject to determination and adjustment as provided in this section.

SEC. 6. That the President is authorized to cause to be erected, maintained, and operated, subject to the International Convention and the Act of Congress to regulate radio-communication, at suitable places along the Panama Canal and the coast adjacent to its two terminals, in connection with the operation of said canal, such wireless telegraphic installations as he may deem necessary for the operation, maintenance, sanitation, and protection of said canal, and for other purposes. If it is found necessary to locate such installations upon territory of the Republic of Panama, the President is authorized to make such agreement with said Government as may be necessary, and also to provide for the acceptance and transmission, by said system, of all private and commercial messages, and those of the Government of Panama, on such terms and for such tolls as the President may prescribe: *Provided*, That the messages of the Government of the United States and the departments thereof, and the management of the Panama Canal, shall always be given precedence over all other messages. The President is also authorized, in his discretion, to enter into such operating agreements or leases with any private wireless company or companies as may best insure freedom from interference with the wireless telegraphic installations established by the United States. The President is also authorized to establish, maintain, and operate, through the Panama Railroad Company, or otherwise, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances, for the purpose of providing coal and other

materials, labor, repairs, and supplies for vessels of the Government of the United States and, incidentally, for supplying such at reasonable prices to passing vessels, in accordance with appropriations hereby authorized to be made from time to time by Congress as a part of the maintenance and operation of the said canal. Moneys received from the conduct of said business may be expended and reinvested for such purposes without being covered into the Treasury of the United States; and such moneys are hereby appropriated for such purposes, but all deposits of such funds shall be subject to the provisions of existing law relating to the deposit of other public funds of the United States, and any net profits accruing from such business shall annually be covered into the Treasury of the United States. Monthly reports of such receipts and expenditures shall be made to the President by the persons in charge, and annual reports shall be made to the Congress.

SEC. 7. That the governor of the Panama Canal shall, in connection with the operation of such canal, have official control and jurisdiction over the Canal Zone and shall perform all duties in connection with the civil government of the Canal Zone, which is to be held, treated, and governed as an adjunct of such Panama Canal. Unless in this Act otherwise provided all existing laws of the Canal Zone referring to the civil governor or the civil administration of the Canal Zone shall be applicable to the governor of the Panama Canal, who shall perform all such executive and administrative duties required by existing law. The President is authorized to determine or cause to be determined what towns shall exist in the Canal Zone and subdivide and from time to time resubdivide said Canal Zone into subdivisions, to be designated by name or number, so that there shall be situated one town in each subdivision, and the boundaries of each subdivision shall be clearly defined. In each town there shall be a magistrate's court with exclusive original jurisdiction coextensive with the subdivision in which it is situated of all civil cases in which the principal sum claimed does not exceed three hundred dollars, and all criminal cases wherein the punishment that may be imposed shall not exceed a fine of one hundred dollars, or imprisonment not exceeding thirty days, or both, and all violations of police regulations and ordinances and all actions involving possession or title to personal property or the forcible entry and detainer of real estate. Such magistrates shall also hold preliminary investigations in charges of felony and offenses under section ten of this Act, and commit or bail in bailable cases to the district court. A sufficient number of magistrates and constables, who must be citizens of the United States, to conduct the business of such courts, shall be appointed by the governor of the Panama Canal for terms of four years and until their successors are appointed and qualified, and the compensation of such persons shall be fixed by the President, or by his authority, until such time as Congress may by law regulate the same. The rules governing said courts and prescribing the duties of said magistrates and constables, oaths and bonds, the times and places of holding such courts, the disposition of fines, costs, forfeitures, enforcements of judgments, providing for appeals therefrom to the district court, and the disposition, treatment, and pardon of convicts shall be established by order of the President. The governor of the Panama Canal shall appoint all notaries public, prescribe their powers and duties, their official seal, and the fees to be charged and collected by them.

SEC. 8. That there shall be in the Canal Zone one district court with two divisions, one including Balboa and the other including Cristobal; and one district judge of the said district, who shall hold his court in both divisions at such time as he may designate by order, at least once a month in each division. The rules of practice in such district court shall be prescribed or amended by order of the President. The said district court shall have original jurisdiction of all felony cases, of offenses arising under section ten of this Act, all causes in equity; admiralty and all cases at law involving principal sums exceeding three hundred dollars and all appeals from judgments rendered in magistrates' courts. The jurisdiction in admiralty herein conferred upon the district judge and the district court shall be the same that is exercised by the United States district judges and the United States district courts, and the precedure and practice shall also be the same. The district court or the judge thereof shall also have jurisdiction of all other matters and proceedings not herein provided for which are now within the jurisdiction of the Supreme Court of the Canal Zone, of the Circuit Court of the Canal Zone, the District Court of the Canal Zone, or the judges thereof. Said judge shall provide for the selection, summoning, serving, and compensation of jurors from among the citizens of the United States, to be subject to jury duty in either division of such district, and a jury shall be had in any criminal case or civil case at law originating in said court on the demand of either party. There shall be a district attorney and a marshal for said district. It shall be the duty of the district attorney to conduct all business, civil and criminal, for the Government, and to advise the governor of the Panama Canal on all legal questions touching the operation of the canal and the administration of civil affairs. It shall be the duty of the marshal to execute all process of the court, preserve order therein, and do all things incident to the office of marshal. The district judge, the district attorney, and the marshal shall be appointed by the President, by and with the advice and consent of the Senate, for terms of four years each, and until their successors are appointed and qualified, and during their terms of office shall reside within the Canal Zone, and shall hold no other office nor serve on any official board or commission nor receive any emoluments except their salaries. The district judge shall receive the same salary paid the district judges of the United States, and shall appoint the clerk of said court, and may appoint one assistant when necessary, who shall receive salaries to be fixed by the President. The district judge shall be entitled to six weeks' leave of absence each year with pay. During this absence or during any period of disability or disqualification from sickness or otherwise to discharge his duties the same shall be temporarily performed by any circuit or district judge

of the United States who may be designated by the President, and who, during such service, shall receive the additional mileage and per diem allowed by law to district judges of the United States when holding court away from their homes. The district attorney and the marshal shall be paid each a salary of five thousand dollars per annum.

SEC. 9. That the records of the existing courts and all causes, proceedings, and criminal prosecutions pending therein as shown by the dockets thereof, except as herein otherwise provided, shall immediately upon the organization of the courts created by this Act be transferred to such new courts having jurisdiction of like cases, be entered upon the dockets thereof, and proceed as if they had originally been brought therein, whereupon all the existing courts, except the supreme court of the Canal Zone, shall cease to exist. The President may continue the supreme court of the Canal Zone and retain the judges thereof in office for such time as to him may seem necessary to determine finally any causes and proceedings which may be pending therein. All laws of the Canal Zone imposing duties upon the clerks or ministerial officers of existing courts shall apply and impose such duties upon the clerks and ministerial officers of the new courts created by this Act having jurisdiction of like cases, matters, and duties.

All existing laws in the Canal Zone governing practice and procedure in existing courts shall be applicable and adapted to the practice and procedure in the new courts.

The Circuit Court of Appeals of the Fifth Circuit of the United States shall have jurisdiction to review, revise, modify, reverse, or affirm the final judgments and decrees of the District Court of the Canal Zone and to render such judgments as in the opinion of the said appellate court should have been rendered by the trial court in all actions and proceedings in which the Constitution, or any statute, treaty, title, right, or privilege of the United States, is involved and a right thereunder denied, and in cases in which the value in controversy exceeds one thousand dollars, to be ascertained by the oath of either party, or by other competent evidence, and also in criminal causes wherein the offense charged is punishable as a felony. And such appellate jurisdiction, subject to the right of review by or appeal to the Supreme Court of the United States as in other cases authorized by law, may be exercised by said circuit court of appeals in the same manner, under the same regulations, and by the same procedure as nearly as practicable as is done in reviewing the final judgments and decrees of the district courts of the United States.

SEC. 10. That after the Panama Canal shall have been completed and opened, for operation the governor of the Panama Canal shall have the right to make such rules and regulations, subject to the approval of the President, touching the right of any person to remain upon or pass over any part of the Canal Zone as may be necessary. Any person violating any of such rules or regulations shall be guilty of a misdemeanor, and on conviction in the District Court of the Canal Zone shall be punished by a fine not exceeding five hundred dollars or by imprisonment not exceeding a year, or both, in the discretion of the court. It shall be unlawful for any person, by any means or in any way, to injure or obstruct, or attempt to injure or obstruct, any part of the Panama Canal or the locks thereof or the approaches thereto. Any person violating this provision shall be guilty of a felony, and on conviction in the District Court of the Canal Zone shall be punished by a fine not exceeding ten thousand dollars or by imprisonment not exceeding twenty years, or both, in the discretion of the court. If the act shall cause the death of any person within a year and a day thereafter, the person so convicted shall be guilty of murder and shall be punished accordingly.

SEC. 11. That section five of the Act to regulate commerce, approved February fourth, eighteen hundred and eighty-seven, as heretofore amended, is hereby amended by adding thereto a new paragraph at the end thereof, as follows:

"From and after the first day of July, nineteen hundred and fourteen, it shall be unlawful for any railroad company or other common carrier subject to the Act to regulate commerce to own, lease, operate, control, or have any interest whatsoever (by stock ownership or otherwise, either directly, indirectly, through any holding company, or by stockholders or directors in common, or in any other manner) in any common carrier by water operated through the Panama Canal or elsewhere with which said railroad or other carrier aforesaid does or may compete for traffic or any vessel carrying freight or passengers upon said water route or elsewhere with which said railroad or other carrier aforesaid does or may compete for traffic; and in case of the violation of this provision each day in which such violation continues shall be deemed a separate offense."

Jurisdiction is hereby conferred on the Interstate Commerce Commission to determine questions of fact as to the competition or possibility of competition, after full hearing, on the application of any railroad company or other carrier. Such application may be filed for the purpose of determining whether any existing service is in violation of this section and pray for an order permitting the continuance of any vessel or vessels already in operation, or for the purpose of asking an order to install new service not in conflict with the provisions of this paragraph. The commission may on its own motion or the application of any shipper institute proceedings to inquire into the operation of any vessel in use by any railroad or other carrier which has not applied to the commission and had the question of competition or the possibility of competition determined as herein provided. In all such cases the order of said commission shall be final.

If the Interstate Commerce Commission shall be of the opinion that any such existing specified service by water other than through the Panama Canal is being operated in the interest of the public and is of advantage to the convenience and commerce of the people, and that such extension will neither exclude, prevent, nor reduce competition on the route by water under consideration, the Interstate Commerce Commission may, by order, extend the time during which such service by water may continue to be operated beyond July first, nineteen

hundred and fourteen. In every case of such extension the rates, schedules, and practices of such water carrier shall be filed with the Interstate Commerce Commission and shall be subject to the act to regulate commerce and all amendments thereto in the same manner and to the same extent as is the railroad or other common carrier controlling such water carrier or interested in any manner in its operation: *Provided*, Any application for extension under the terms of this provision filed with the Interstate Commerce Commission prior to July first, nineteen hundred and fourteen, but for any reason not heard and disposed of before said date, may be considered and granted thereafter.

No vessel permitted to engage in the coastwise or foreign trade of the United States shall be permitted to enter or pass through said canal if such ship is owned, chartered, operated, or controlled by any person or company which is doing business in violation of the provisions of the Act of Congress approved July second, eighteen hundred and ninety, entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," or the provisions of sections seventy-three to seventy-seven, both inclusive, of an Act approved August twenty-seventh, eighteen hundred and ninety-four, entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purposes," or the provisions of any other Act of Congress amending or supplementing the said Act of July second, eighteen hundred and ninety, commonly known as the Sherman Antitrust Act, and amendments thereto, or said sections of the Act of August twenty-seventy, eighteen hundred and ninety-four. The question of fact may be determined by the judgment of any court of the United States of competent jurisdiction in any cause pending before it to which the owners or operators of such ship are parties. Suit may be brought by any shipper or by the Attorney General of the United States.

That section six of said Act to regulate commerce, as heretofore amended, is hereby amended by adding a new paragraph at the end thereof, as follows:

"When property may be or is transported from point to point in the United States by rail and water through the Panama Canal or otherwise, the transportation being by a common carrier or carriers, and not entirely within the limits of a single State, the Interstate Commerce Commission shall have jurisdiction of such transportation and of the carriers, both by rail and by water, which may or do engage in the same, in the following particulars, in addition to the jurisdiction given by the Act to regulate commerce, as amended June eighteenth, nineteen hundred and ten:

"(a) To establish physical connection between the lines of the rail carrier and the dock of the water carrier by directing the rail carrier to make suitable connection between its line and a track or tracks which have been constructed from the dock to the limits of its right of way, or by directing either or both the rail and water carrier, individually or in connection with one another, to construct and connect with the lines of the rail carrier a spur track or tracks to the dock. This provision shall only apply where such connection is reasonably practicable, can be made with safety to the public, and where the amount of business to be handled is sufficient to justify the outlay.

"The commission shall have full authority to determine the terms and conditions upon which these connecting tracks, when constructed, shall be operated, and it may, either in the construction or the operation of such tracks, determine what sum shall be paid to or by either carrier. The provisions of this paragraph shall extend to cases where the dock is owned by other parties than the carrier involved.

"(b) To establish through routes and maximum joint rates between and over such rail and water lines, and to determine all the terms and conditions under which such lines shall be operated in the handling of the traffic embraced.

"(c) To establish maximum proportional rates by rail to and from the ports to which the traffic is brought, or from which it is taken by the water carrier, and to determine to what traffic and in connection with what vessels and upon what terms and conditions such rates shall apply. By proportional rates are meant those which differ from the corresponding local rates to and from the port and which apply only to traffic which has been brought to the port or is carried from the port by a common carrier by water.

"(d) If any rail carrier subject to the Act to regulate commerce enters into arrangements with any water carrier operating from a port in the United States to a foreign country, through the Panama Canal or otherwise, for the handling of through business between interior points of the United States and such foreign country, the Interstate Commerce Commission may require such railway to enter into similar arrangements with any or all other lines of steamships operating from said port to the same foreign country."

The orders of the Interstate Commerce Commission relating to this section shall only be made upon formal complaint or in proceedings instituted by the commission of its own motion and after full hearing. The orders provided for in the two amendments to the Act to regulate commerce enacted in this section shall be served in the same manner and enforced by the same penalties and proceedings as are the orders of the commission made under the provisions of section fifteen of the Act to regulate commerce, as amended June eighteenth, nineteen hundred and ten, and they may be conditioned for the payment of any sum or the giving of security for the payment of any sum or the discharge of any obligation which may be required by the terms of said order.

SEC. 12. That all laws and treaties relating to the extradition of persons accused of crime in force in the United States, to the extent that they may not be in conflict with or superseded by any special treaty entered into between the United States and the Republic of Panama with respect to the Canal Zone, and all laws relating to the rendition of fugitives from justice as between the several States and Territories of the United States, shall extend to and be considered in force in the Canal Zone, and for such purposes and such purposes only the Canal Zone shall be considered and treated as an organized territory of the United States.

SEC. 13. That in time of war in which the United States shall be engaged, or when, in the opinion of the President, war is imminent, such officer of the Army as the President may designate shall, upon the order of the President, assume and have exclusive authority and jurisdiction over the operation of the Panama Canal and all its adjuncts, appendants, and appurtenances, including the entire control and government of the Canal Zone, and during a continuance of such condition the governor of the Panama Canal shall, in all respects and particulars as to the operation of such Panama Canal, and all duties, matters, and transactions affecting the Canal Zone, be subject to the order and direction of such officer of the Army.

SEC. 14. That this Act shall be known as, and referred to as, the Panama Canal Act, and the right to alter, amend, or repeal any or all of its provisions or to extend, modify, or annul any rule or regulation made under its authority is expressly reserved.

REPEAL OF TOLLS EXEMPTION CLAUSE

APPROVED JUNE 15, 1914

An Act To amend section five of "An Act to provide for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone," approved August twenty-fourth, nineteen hundred and twelve.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the second sentence in section five of the Act entitled "An Act to provide for the opening, maintenance, protection, and operation of the Panama Canal, and the sanitation and government of the Canal Zone," approved August twenty-fourth, nineteen hundred and twelve, which reads as follows: "No tolls shall be levied upon vessels engaged in the coastwise trade of the United States," be, and the same is hereby, repealed.

SEC. 2. That the third sentence of the third paragraph of said section of said Act be so amended as to read as follows: "When based upon net registered tonnage for ships of commerce the tolls shall not exceed $1.25 per net registered ton, nor be less than 75 cents per net registered ton, subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three": *Provided*, That the passage of this Act shall not be construed or held as a waiver or relinquishment of any right the United States may have under the treaty with Great Britain, ratified the twenty-first of February, nineteen hundred and two, or the treaty with the Republic of Panama, ratified February twenty-sixth, nineteen hundred and four, or otherwise, to discriminate in favor of its vessels by exempting the vessels of the United States or its citizens from the payment of tolls for passage through said canal, or as in any way waiving, impairing, or affecting any right of the United States under said treaties, or otherwise, with respect to the sovereignty over or the ownership, control, and management of said canal and the regulation of the conditions or charges of traffic through the same.

ADMISSION OF FOREIGN-BUILT SHIPS TO AMERICAN REGISTER

APPROVED AUGUST 18, 1914

An Act To provide for the admission of foreign-built ships to American registry for the foreign trade, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the words "not more than five years old at the time they apply for registry" in section five of the Act entitled "An Act to provide for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone," are hereby repealed.

SEC. 2. That the President of the United States is hereby authorized, whenever in his discretion the needs of foreign commerce may require, to suspend by order, so far and for such length of time as he may deem desirable, the provisions of law prescribing that all the watch officers of vessels of the United States registered for foreign trade shall be citizens of the United States.

Under like conditions, in like manner, and to like extent the President of the United States is also hereby authorized to suspend the provisions of the law requiring survey, inspection, and measurement by officers of the United States of foreign-built vessels admitted to American registry under this Act.

SEC. 3. This Act shall take effect immediately.

PANAMA CANAL TOLL RATES

PROCLAMATION BY THE PRESIDENT, NOV. 13, 1912

I, William Howard Taft, President of the United States of America, by virtue of the power and authority vested in me by the act of Congress approved August twenty-fourth, nineteen hundred and twelve, to provide for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone, do hereby prescribe and proclaim the following rates of toll to be paid by vessels using the Panama Canal:

1. On merchant vessels carrying passengers or

cargo, one dollar and twenty cents ($1.20) per net vessel ton—each one hundred (100) cubic feet—of actual earning capacity.

2. On vessels in ballast without passengers or cargo, forty (40) per cent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels, other than transports, colliers, hospital ships, and supply ships, fifty (50) cents per displacement ton.

4. Upon army and navy transports, colliers, hospital ships, and supply ships, one dollar and twenty cents ($1.20) per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

The Secretary of War will prepare and prescribe such rules for the measurement of vessels and such regulations as may be necessary and proper to carry this proclamation into full force and effect.

In witness whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the city of Washington this thirteenth day of November, in the year of our Lord one thousand nine hundred and twelve, and of the independence of the United States the one hundred and thirty-seventh.

[SEAL.] WM. H. TAFT.

By the President:

P. C. KNOX,
Secretary of State.

EXECUTIVE ORDER

JAN. 27, 1914

CREATING A PERMANENT ORGANIZATION FOR THE PANAMA CANAL, EFFECTIVE APRIL 1, 1914

By virtue of the authority vested in me, I hereby enact the following order, creating a permanent organization for the Panama Canal, under the Act of Congress "To provide for the opening, maintenance, protection and operation of the Panama Canal and the sanitation and government of the Canal Zone," approved August 24, 1912.

SECTION 1. The organization for the completion, maintenance, operation, government and sanitation of the Panama Canal and its adjuncts and the government of the Canal Zone shall consist of the following departments, offices and agencies, and such others as may be established by the Governor of the Panama Canal on the Isthmus or elsewhere with the approval of the President, all to be under the direction of the Governor, subject to the supervision of the Secretary of War.

DEPARTMENT OF OPERATION AND MAINTENANCE—There shall be a Department of Operation and Maintenance under the immediate supervision and direction of the Governor of the Panama Canal. This Department shall be charged with the construction of the Canal and with its operation and maintenance when completed, including all matters relating to traffic of the Canal and its adjuncts, and the operation and maintenance of beacons, lights and lighthouses; the supervision of ports and waterways, including pilotage; the admeasuring and inspecting of vessels, including hulls and boilers; the operation and maintenance of the Panama Railroad upon the Isthmus, including telephone and telegraph systems; the operation of locks, coaling plants, shops, dry-docks and wharves; office engineering, including meteorology and hydrography; the construction of buildings and sanitary and municipal engineering, including the construction and maintenance of drainage ditches, streets, roads and bridges.

PURCHASING DEPARTMENT.—There shall be a Purchasing Department under the supervision and direction of the Governor. This department shall be charged with the purchase of all supplies, machinery or necessary plant.

SUPPLY DEPARTMENT.—There shall be a Supply Department, under the supervision and direction of the Chief Quartermaster. This department shall store and distribute all material and supplies for use of the Panama Canal and of its employees; and for other departments of the Government on the Isthmus and their employees; and for vessels of the United States and for other vessels, when required. The Supply Department shall operate commissaries, hotels and messes; shall be in charge of the maintenance of buildings, the assignment of quarters and the care of grounds; shall recruit and distribute unskilled labor; and shall have charge of the necessary animal transportation.

ACCOUNTING DEPARTMENT.—There shall be an Accounting Department under the supervision and direction of the Auditor, with an assistant in the United States. The duties of the department shall include all general bookkeeping, auditing and accounting, both for money and property, cost-keeping, the examination of payrolls and vouchers, the inspection of time books and of money and property accounts, the preparation of statistical data, and the administrative examination of such accounts as are required to be submitted to the United States Treasury Department; and the collection, custody and disbursement of funds for the Panama Canal and the Canal Zone. These same duties shall be performed for the Panama Railroad Company on the Isthmus when not inconsistent with the charter and by-laws of that Company. The department shall be charged with the handling of claims for compensation on account of personal injuries and of claims for damages to vessels. Within the limits fixed by law, the duties and financial responsibilities of the officers and employees charged with the receipt, custody, disbursement, auditing and accounting for funds and property shall be prescribed in regulations issued by the Governor, with the approval of the President. The Auditor shall maintain such a system of bookkeeping as will enable him to furnish at any time full, complete and correct information in regard to

the status of appropriations made by Congress, the status of all other funds, and the amounts of net profits on all operations, which are to be covered into the Treasury as required by the Panama Canal Act.

HEALTH DEPARTMENT.—There shall be a Health Department under the supervision and direction of the Chief Health Officer. This department shall be charged with all matters relating to maritime sanitation and quarantine in the ports and waters of the Canal Zone and in the harbors of the cities of Panama and Colon, and with land sanitation in the Canal Zone, and sanitary matters in said cities in conformity with the Canal Treaty between the United States and the Republic of Panama and existing agreements between the two governments thereunder, and all matters relating to hospitals and charities.

EXECUTIVE SECRETARY.—There shall be an Executive Secretary who, under the direction of the Governor of the Panama Canal, shall be charged with the supervision of all matters relating to the keeping of time of employees; to postoffices, customs, taxes and excises, excepting the collection thereof; police and prisons; fire protection; land office; schools, clubs and law library; the custody of files and records; and the administration of estates of deceased and insane employees. He shall, in person or through one of his assistants, perform the duties of a Shipping Commissioner. He shall conduct all correspondence and communications between the authorities of the Canal Zone and the Government of the Republic of Panama and such other correspondence as may be given him in charge by the Governor. He shall have charge of the seal of the Government of the Canal Zone and shall attest such acts of the Government as are required by law to be performed and done under the seal.

The duties herein prescribed for the foregoing departments, offices and agencies will be assigned to divisions or bureaus thereunder by the Governor of the Panama Canal, as the necessities therefor arise. Each of the foregoing departments shall discharge such further duties as may be assigned to it from time to time by the Governor; and the Governor, with the approval of the President, may transfer from time to time specific duties from one department to another.

SECTION 2. The organization provided for in Section 1 shall be, in general, in accordance with the outline chart accompanying the memorandum of Jan. 27, 1914, entitled "Memorandum to accompany Executive Order of Jan. 27, 1914, providing for a permanent organization for the Panama Canal," and officers from certain departments shall be detailed in accordance with that memorandum.

SECTION 3. This order shall take effect from and after the 1st day of April, 1914, from which date the Isthmian Canal Commission, together with the present organization for the Panama Canal and the Canal Zone, shall cease to exist, in accordance with the terms of the above-mentioned Act of Congress.

WOODROW WILSON.

THE WHITE HOUSE,
January 27, 1914.

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